Stage 1 - Identifying Desired Results of Learning (Review of Stage 1)

Establish Goals: (G)

- **Goals - CCSS**
- **Common Core State Standards**
- **Content Area:** Geometry
- **Grade Level:** High School
- **Domain:** Expressing Geometric Properties with Equations
- **Cluster:** Translate between the geometric description and the equation for a conic section
- **Standard(s):**
    - Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.
    - Derive the equation of a parabola given a focus and directrix.
    - In addition… Introduce ellipses and hyperbolas

List the prerequisite skills:
Solve linear equations

Students will understand that: (U)

- being able to construct parabolas and circles will be useful in understanding the different conic sections, and that it will be the basis for moving forward with completing the square.
- completing the square is used with each of the conic sections, but we will start with parabolas and circles, and later apply them to ellipses and hyperbolas.
- conic sections provide the basis for a variety of shapes and equations that are used all around them and will appear more in Algebra II.

Essential Questions (Q)

- why is completing the square important and where is it applied in real life?
- how are parabolas created with geometry and where do they appear in the real world?
- where are conic sections applied in the real world, and what types of shapes do they form?

Students will know: (K)

- different shapes formed by conic sections (Circles, Ellipses, Parabolas, and Hyperbolas) and their equations.
- terminology such as: center, focus, vertex, directrix, axis, major axis, minor axis, locus, etc...
- visual representations of all conic sections and how to construct them.

Students will be able to: (S)

- derive the formulas for all the conic sections (U3)
- illustrate parabolas and circles from equations and real world examples (U2)
- construct circles and parabolas (U1)
- derive the equation for a circle using the Pythagorean Theorem (U1)
- analyze hyperbolas and ellipses and how they relate to the real world (U3)
- consider the differences in the conic sections and how completing the square differs between them (U2)
- recognize when to complete the square (U2)

http://www.purplemath.com/modules/conics.htm

Stage 2 - Determine Acceptable Evidence

Unit Understanding for Performance Task from Stage 1:

- completing the square is used with each of the conic sections, but we will start with parabolas and circles, and later apply them to ellipses and hyperbolas.
- parabolas and circles created using geometry are used in the real world.
- conic sections provide the basis for a variety of shapes and equations that are used all around them and will appear more in Algebra II.

Establish Goals: (G)

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    - In addition… Introduce ellipses and hyperbolas

Performance Task (Summary in G.R.A.S.P.S. form):

Goal: The student will create a piece of art that will impress mathematicians and get him/her a raise.
Role: The student is the artist.
Audience: Top mathematicians from around the world will be in attendance to see the artwork.
Situation: A beautiful gallery for the Virtual Math Museum in the most formal of settings.
Product: An elegant piece of artwork created on Desmos.
Presentation: Formal presentation in front of the class explaining their piece of art and what makes it unique
Standards (list categories for each of the following rubrics)

Product Rubric:

Required Elements 30%
Originality 10%
Detail and Creativity 20%
Understanding of Math Concepts 25%
Understanding of Desmos 15%

http://www.rcampus.com/rubricshowc.cfm?code=DX3BWC9&sp=yes

Other Evidence (OE)
Describe the Formative Assessments:
1. Pre-Requisite Skills Assessment (list pre-requisite skills and describe how you will assess if students are ready for the unit):

Pre-requisite skills that students should know before coming into the unit include an understanding of the cartesian coordinate plane and linear functions.

2. Pre-Assessment for the unit:

Students will be given a writing prompt to articulate how much they know about the material before we start the unit. If there are gifted and talented students who either already know the content or will learn it very quickly, I will challenge them by tiering the work to try and push them to a deeper level of understanding.

3. Strategy used for Checking for Understanding during instruction (1 per lesson).

- Rally Coach--students will be in pairs and will be responsible for the following roles: The coach will need to tell their partner how to complete a problem. The partner, or scribe, can only write what the coach tells him/her to write. Once a problem is completed, the rolls will switch.
- Write what you know--students will be asked to write as much as they know about the topic we are covering. I will ask them to see if they can relate any of it to the real world to deepen their understanding.
- Graph Yo-self--students will be asked to work together to graph themselves on the cartesian coordinate plane on the floor. They will need to graph parabolas, hyperbolas, circles, and ellipses.
- Exit/Entrance Tickets-- students will be asked to complete an entrance ticket before class starts, and an exit ticket after class ends so I can see where they are at in their learning process. This will give me a good understanding of there the students are at before the performance task.

4. Timely Feedback on Products (Self, Peer and Teacher):

- Students will use a checklist to make sure they have all the essential elements for their summative assessments before they get too in depth into their projects.
- After they reflect on their own, they will get in groups of three and share their drafts with their partners. Partners will write down constructive criticism to help improve their summative assessments.
- Following this, when students have started their summative assessments, I will be able to check with them individually to make sure they are on the right track. The posters will be done in class, so I will be able to frequently check with them to make sure progress is going well. The Prezi and iMovie will be done partly in class and out of class so students will be able to meet with me individually or in their groups.

Describe the Summative Assessments (1 per lesson):

- Poster explanation project-- students will create a poster and use their artistic/writing skills to demonstrate the concept of completing the square and how it relates to parabolas and circles.
- Prezi--students will construct a prezi that demonstrates their knowledge of parabolas and circles using the knowledge they already have of completing the square.
- Poster graphing project--Students will create a poster that incorporates the four conic sections and how they are similar and different. Each of these will have a real world example.
- iMovie--students will be in groups and be responsible for creating an iMovie that uses real world visuals to teach their peers about conic sections. They will be tasked with the challenge to act as news crew reporters and demonstrate their deep understanding of each conic section through a movie.

- Performance Task (lesson 5)
- Exam (lesson 6)

Task Description: (T) (Write a descriptive narrative of your GRASPS)

You just got a job as an artist for the Virtual Math Museum. The founder, Jorgan Von Strangle, has asked you to construct a piece that will go on display at the newest open house they will be having. Many of the top mathematicians from around the world will be in attendance, and they will decide whether they would like to sponsor the Virtual Math Museum. The piece Jorgan has asked you to create must be constructed with only parabolas, hyperbolas, ellipses, and circles. You must use Desmos Graphing Calculator to create your image that will be put on display. If

the display you created impresses the mathematicians, they will sponsor the Virtual Math Museum and you will get a handsome raise.

Math - Problem Solving : Virtual Math Museum Art

Teacher Name: **Mr. Cabaniss** Student Name: _____

CATEGORY	Phenominal (5 pts)	Great (4 pts)	Not too shabby (3 pts)	Needs work (1 pt)
Required Elements 30%	The presentation includes all of the required elements (parabolas, hyperbolas, circles, and ellipses) to create the piece of art	The presentation includes three out of the four required elements to create the piece of art	The presentation included two out of the four required elements to create the piece of art	The presentation included one or none of the required elements to create the piece of art
Originality 10%	All of the features included in the piece of art reflect an exceptional degree of student creativity in their creation and display	Several of the features included in the piece of art reflect a great deal of student creativity in their creation and display	The components in the piece of art created by the student reflect little originality and are based off of others' ideas	No components included in the piece of art were created by the student
Detail and Creativity 20%	The piece of art is exceptionally attractive in terms of design, layout, and neatness. The artist can also clearly justify what makes their art so unique	The piece of art is attractive in terms of its design, layout, and neatness. The artist is able to justify what makes their art unique	The piece of art is acceptable in terms of attractiveness. The artist could improve on their justification of the piece	The piece of art is messy and it is clear the artist did not put in the expected effort
Understanding of Mathematical Concepts 25%	The student can accurately answer 90-100% of the questions related to math in the presentation and processes used in Desmos to create the piece of art	The student can accurately answer 50-89% of the questions related to math in the presentation and processes used in Desmos to create the piece of art	The student can accurately answer 25-49% of the questions related to math in the presentation and processes used in Desmos to create the piece of art	Student appears to have insufficient knowledge (can answer less than 25% of the questions) about the math in the presentation or processes used in Desmos to create the piece of art
Understanding of Desmos 15%	The student shows an exceptional understanding of the program and would be able to present with it at a conference	The student shows great understanding with the program and would be able to help out peers with it	The student understands the program well enough to use it. A strong understanding is not apparent	The student does not understand how to use the program. The piece of art clearly reflects the student's inability to use Desmos

UNIVERSITY OF MAINE AT FARMINGTON
COLLEGE OF EDUCATION, HEALTH AND REHABILITATION

LESSON PLAN FORMAT
EDU 361 Secondary/Middle Math Methods

Teacher's Name: Sean Cabaniss **Lesson #:** 1
Grade Level: 10 **Numbers of Days:** 2

Topic: Circles and parabolas
Room Arrangement: The room will be set up in a parabola. A) because it helps with engagement and room cooperation and B) because it would fit right into the lesson with parabolas.

PART I

Objectives:

Students will understand that:

- being able to construct parabolas and circles will be useful in understanding the different conic sections, and that it will be the basis for moving forward with completing the square.

Students will know:

- how to derive the formula for a circle, and how to construct circles and parabolas from scratch.

Students will be able to do:

- construct circles and parabolas
- derive the equation for a circle using the Pythagorean Theorem

Product: Poster explanation project-- students will create a poster and use their artistic/writing skills to demonstrate the concept of completing the square and how it relates to parabolas and circles.

Common Core State Standards (CCSS) Alignment

Content Area: Geometry

Grade Level: High School

Domain: Expressing Geometric Properties with Equations

Cluster: Translate between the geometric description and the equation for a conic section

Standard(s):

- Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.
- Derive the equation of a parabola given a focus and directrix.
- In addition… Introduce ellipses and hyperbolas

Which CCSS Mathematical Practice(s) will be addressed (list the number and the description):

5. Use appropriate tools strategically

Rationale: (for both the CCSS standards and the practice(s))

Through the use of direct instruction and inquiry training, students will be exposed to the standards and will be able to eventually develop their own learning. They will progress to unguided inquiry where they can take control of their learning and explore concepts to a much deeper level. The fifth practice, using appropriate tools strategically, will be important because students will need to use specific tools in order to create both parabolas and circles.

Assessments

Pre-Assessment:

A quick Nearpod presentation that will allow me to do a quick formative assessment and gather results to get a good understanding of the students' knowledge. This will allow me to figure out if I should start on concepts previous to the standards for some or all of the students, or skip some concepts and move onto more advanced topics for some or all of the students.

Formative (Assessment for Learning)

Section I – checking for understanding during instruction

Thumbs up-thumbs down during the time students are able to practice their skills.

Section II – timely feedback for product (self, peer, teacher)

Students will use a checklist to make sure they have all the essential elements for their

summative assessments before they get too in depth into their projects.

After they reflect on their own, they will get in groups of two and share their drafts with their partners. Partners will write down constructive criticism to help improve their summative assessments.

Following this, when students have started their summative assessments, I will be able to check with them individually to make sure they are on the right track. The posters will be done in class, so I will be able to frequently check with them to make sure progress is going well.

Summative (Assessment of Learning): (Description of Product)

Poster explanation project-- students will create a poster and use their artistic/writing skills to demonstrate the concept of creating circles and parabolas and finding the equation of a circle.

Integration

Technology and SAMR Level

Desmos--Technology at the augmentation level that allows for the intuitive creation of graphs and even has the capability of animation. This tool will be used during instruction and the students will be able to utilize it themselves to further their understanding.

Nearpod--Students will be able to join an interactive presentation that consists of a formative pre-assessment. This falls under modification. Their results will be saved for later so I can review them and get a good understanding of where the students are at. This will take place before the first lesson so I can prepare appropriately.

Other Content Areas:

English--Students will have the opportunity to create a poster product where they explain processes through words for their peers to understand. They will need to thoroughly explain processes so anyone looking at the poster will be able to understand.

Instructional Model (Select one: direct instruction, inquiry training, concept attainment, learning cycle, concept of formation, unguided inquiry, cooperative learning) ***NOTE: Must use at least three different instructional models during the unit.***

Direct Instruction and inquiry training will be used. The instructional strategies and templates were taken from "K-12 Classroom Teaching--A Primer for New Professionals", by Andrea M. Guillaume.

Rationale: A hook will get students thinking about what a parabola really is, and they will start to consider different possibilities for how to construct them. Students will be given direct instruction on parabolas and get a good feeling for them before moving onto circles, where they will also be given the opportunity for inquiry training before direct instruction.

Groupings

Section I - Graphic Organizer & Cooperative Learning used during instruction

The graphic organizer 'Describing wheel' will be given to students to use if they find it helpful. This will allow them to put steps and processes in order for how to create a parabola given only two pieces of information. The cooperative learning model will be how the students communicate their ideas for their posters to each other, and the feedback they get from it.

Section II – Groups and Roles for Product

Students will be responsible for equally distributing responsibilities for the poster. They will be in groups of two so there should be plenty for each student to do. They will end up doing a short feedback questionnaire for me to get a good idea of how much effort was put in by each student.

Differentiated Instruction

Motivational Strategy (Tell which Posamentier and Krulik motivational strategy will be used and credit them. Describe how you are using it and why.) ***NOTE: Use a variety across the unit.***

I will use a hook for each class. First, by employing teacher-made or commercially prepared materials, I will be using a cone and slicing it to show the different sections and, more specifically, show how to get a parabola from a specific slice. Second, by way of enticing the class with a "Gee-whiz" Amazing Mathematical Result, I will show them a video of crop circles and how incredibly circular they are for being hand made.

Motivational strategies were taken from "The Art of Motivating Students--For Mathematics Instruction" written by Alfred S, Posamentier and Stephen Krulik.

Multiple Intelligences Strategies

Logical: Students will be given the opportunity to think their way through topics before instruction occurs. This will allow them to let their mind explore different possibilities before they get direct instruction.

Verbal: Students will have the opportunity to explain how they arrived at specific answers, and they will also get to hear my explanations of direct instruction in addition to the written out examples.

Visual: Students will be able to look at graphs either drawn on the board or created using technology.
Intrapersonal: Students will be given plenty of opportunities to work alone on problems.
Interpersonal: Through the use of the outside activities, students will be able to work with one another to access their cooperative learning minds.
Kinesthetic: Students will be able to go outside and construct parabolas and circles.
Naturalist: Students will be able to go outside and construct both parabolas and circles.

Modifications/Accommodations
From IEP's (Individual Education Plan), 504's, ELLIDEP (English Language Learning Instructional Delivery Education Plan) *I will review student's IEP, 504 or ELLIDEP and make appropriate modifications and accommodations.*

Plan for students who are missing pre-requisite skill(s):
Although tiering can work, I do not want some students drastically ahead of others. Therefore missing pre-requisite skills will be taught as they become relevant in the class. Students who I feel grasp concepts well will be strategically placed in the room near Evangeline, Rabiu, and Mutumbo, who are lacking pre-requisite skills. These three students, and others who are struggling, will be encouraged to advocate for themselves so they can get the most out of their learning. They will do this by either asking me or a peer who may be able to help them.

Plan for accommodating Special Education:
Both Mutumbo and Rob are receiving special education services and have an IEP that outlines modifications and accommodations that are specific to their learning. They are almost entirely immersed in my classroom, but will have a resource room with additional attention if they need it. However, I will provide as much support as I need to, and their peers will be able to assume leadership roles to assist them as well.

Plan for accommodating English Language Learners:
Each lesson will be made so that there are plenty of visuals and Rusney, Gisele, and Krystopher will be able to work hands on to get a grasp on the concepts. Conversation about parabolas and circles will happen, although there will be numerous opportunities to construct and build which leaves time for one on one attention if needed.

Plan for accommodating absent students:
Through the use of my Weebly webpage, I will be able to update it and keep a detailed agenda of what was covered in class. Students will still be responsible for coming to see me to get the required papers they missed. In addition, students will have their success teams that they can always fall back on to check with to make sure they have all the necessary information.

Extensions (tiering, gifted students, the students who already know it, etc…)
Sam, Damien, Grace, and Gisele are all student who perform above and beyond in the math classroom. These students will have the opportunity to push themselves to the next level with the construction of other geometric shapes graphically. They may be asked, after an individual meeting with the student, to do some independent research to further their understanding of specific topics. These students may also be used as an aid to me to assist students who are struggling with the material.

Materials, Resources and Technology

Graphic organizer
Ruler
Rope
Compass

Source for Lesson Plan and Research short description of each and keep adding more sources

How to construct a parabolas--http://www.purplemath.com/modules/parabola.htm
Activities for working with circles and parabolas--http://illuminations.nctm.org/Activity.aspx?id=3506
How to construct a circle using the Pythagorean Theorem--https://www.khanacademy.org/math/geometry/cc-geometry-circles/equation-of-a-circle/v/equation-for-a-circle-using-the-pythagorean-theorem
More on constructing parabolas--http://www.mathsisfun.com/geometry/parabola.html

PART II: *Note: The purpose of Part II is to take everything from Part I and make it come alive with details in such a way that you can easily teach from it but also a substitute unfamiliar with your content area could carry out the lesson.*

Agenda:

Day 1 (80 min):
Cool random math (5 min)
Pre-assessment (10 min)
Hook for parabolas (5 min)
Developing questions with groups, and answering prompted questions (10 min)
Direct instruction for constructing parabolas (15 min)

Individual work time for examples (10 min)
Outdoor construction of parabolas with partner (20 min)

Day 2 (80 min):
Cool random math (5 min)
Previous class check in (5 min)
Hook for circles (5 min)
Developing questions with groups, and answering prompted questions (10 min)
Direct instruction for constructing circles and deriving formula (15 min)
Individual work time for practicing examples (10 min)
Project planning/conference time (10 min)
Outdoor construction of circles with partner (20 min)

Teaching and Learning Sequence (2-3 pages)

At the beginning of each day students will be exposed to a "cool random math thing" that will not be part of the curriculum. It will either be a video, optical illusion, or cool discovery in mathematics that will hopefully show them the wide variety of math there is to explore and discover. This should only take five minutes.

Direct Instruction Lesson
Objectives: Students will be able to construct both parabolas and circles. In addition, they will be able to complete the square for each of the two conic sections and relate them to the real world.

Day 1:

Cool random math (5 min): Intro to Fibonacci Sequence

Now students will use their laptops or iPads to go to nearpod.com for an online pre-assessment. Here there will be a presentation that students can sign into that will allow them to go through questions at their own pace. Once they complete the assessment, their results will be sent to me so I can view them and get a good feel for the rest of my lessons with where the students are at (10 min)

Parabola hook (5 min): Take a cone of some sort and slice it with a sword to create a parabola. Kids will probably love this. See content notes for illustration

Open

Anticipatory set:
Student will then get into groups to start conversation about parabolas and they will start to develop some questions that will get them thinking. After they have discussed for about five minutes, they will be given a couple more questions from me that will try to push their thinking further (10 min):

- How could you possibly construct a parabola?
- What is unique about parabolas and quadratic functions that makes it different from linear functions?

Body

Direct instruction (15 min): Everyone needs to get out a piece of paper and with a ruler, draw a line at the bottom of your piece of paper that is parallel with the edge, label this the directrix. Then draw a line perpendicular to the directrix that is centered on the paper, label this the axis of symmetry. Then draw a point that is two inches up from the directrix, and on the axis of symmetry, label this your focus. Now find the midpoint between the focus and the directrix, label this as your vertex. Now draw four lines that are two inches apart perpendicular to your axis of symmetry and label them 'a' thru 'd'. Using your compass, measure the distance from a to the directrix. This distance will be the same distance from your focus to a spot on the line perpendicular to 'a'. Take this same distance on the other side of the axis of symmetry. Repeat this process for the rest of the points 'b' thru 'd'. Once that is completed draw the curve through the points created by the previous step. See content notes for this example (1)

Guided practice:
Now on graph paper, try these two examples (10 min):

1. Directrix = (1,1), focus = (1,4)
2. Directrix = (-1,-2), focus = (3, -2)... This one will make them confused… Why can it be on its side. (Example 2 in content notes)

As students work I will be able to gauge their level by doing thumbs up-thumbs down. I will also be able to walk around the room and make sure students are completing their work well. This will allow students who are excelling to use their leadership and help other students as needed.

Students will then get with partners who they will work with for for activities outdoors as well as their summative assessment. Their partners will change for each lesson so they have the opportunity to work with other students who think differently. Before they leave class they will have time to figure out how they would like to start their poster and h

(30 min) Outside we will stick together in an area that has plenty of concrete or tar space to build parabolas. They will get to choose the dimensions for their construction. This is where the rope

will come into play, because they will use this to get the distances from the points on the axis of symmetry to the directrix and use it to get the same distance from the focus to a point on the line perpendicular to the axis of symmetry. I will be circulating around to see how things are going. This will be a first test on who they choose as partners. If it goes well and everyone is learning, they can continue to choose partners; however, if I feel there isn't enough focus or some students are struggling I will put some students who are doing well with the students who are struggling to ensure maximum learning.

Close

Now I will give them a quick five minute demonstration of their homework on Line Rider before going outside.

Independent practice:
Math Mission: Go to Line Rider and construct your very own parabola. Name your rider and make sure he is able to complete the course without dying. Be sure to save your course on your laptop. Take a screenshot and email it to me. We will use the Apple TV to project some courses that are above and beyond expectation.

Day 2:

Cool Random Math (5 min): Part two of Fibonacci Sequence

Quick animation of constructing a parabola to remind them of what they did the previous class.

Open
Entrance ticket (5 min check-in) that is a review of the previous class' content.

Hook for circles (5 min)

Students will then get in groups for about ten minutes and discuss circles and start developing some thoughts of their own. Directly following this I will give them a few questions to consider and continue the conversations in their groups (10 min):

- What is the easiest way to construct a circle?
- What other resources could you use to construct a circle?
- What type of equation could form a circle?

Body

Example 3: Students will have graph paper and a compass to be able to complete the construction of circles. We will then start looking into how to get the formula for a circle from the pythagorean theorem. On graph paper, students will draw a circle and a right triangle at the center. Using radius 'r' and a point on the circle (x,y), they will be able to find the side lengths of the triangle using the pythagorean theorem and it will be the general form for any circle (15 min).

Guided practice:
Example 4 (10 min): Graph the following circles on graph paper: center at (3,5) with radius 2. And $(x-2)^2+(y-1)^2=9$

Now students will have the chance to get together again and fill out a checklist and have individual meeting time with me before they get too in depth into their project. They will work on their project for their math mission, and have the opportunity to finish it during the time of the next lesson (10 min)

Close
Independent practice:
Students will go outside and use sidewalk chalk with partners to construct circles of different sizes. They will use the rope as their radius with one person standing in the center and the other walking around the outside to create a smooth arc. They will have some autonomy to create any size circle they want (20 min)

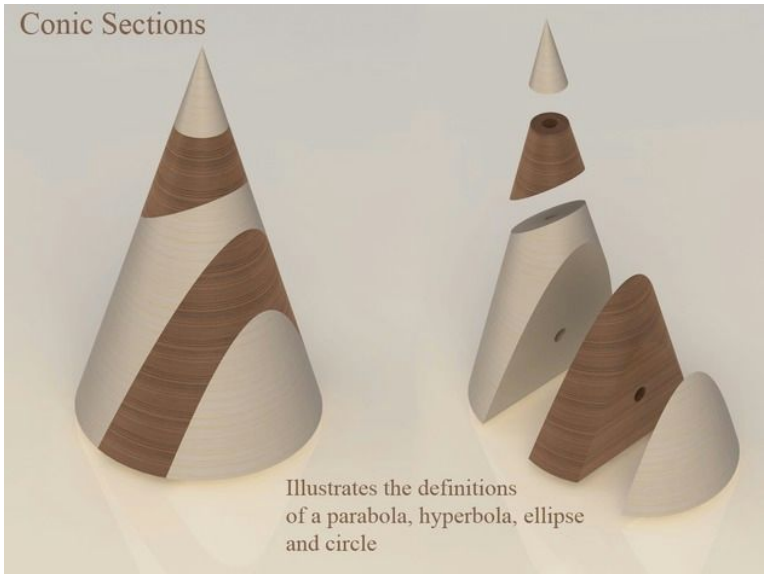
Math mission: Do problems 1-4 and 9-14. Problems 5,6,7,and 8 involve completing the square which will be talked about in the next lesson Circle Worksheet. In addition, they should be finding time to work with their partners for their projects that will be due, and hung up around the room, within two more classes.

Handouts

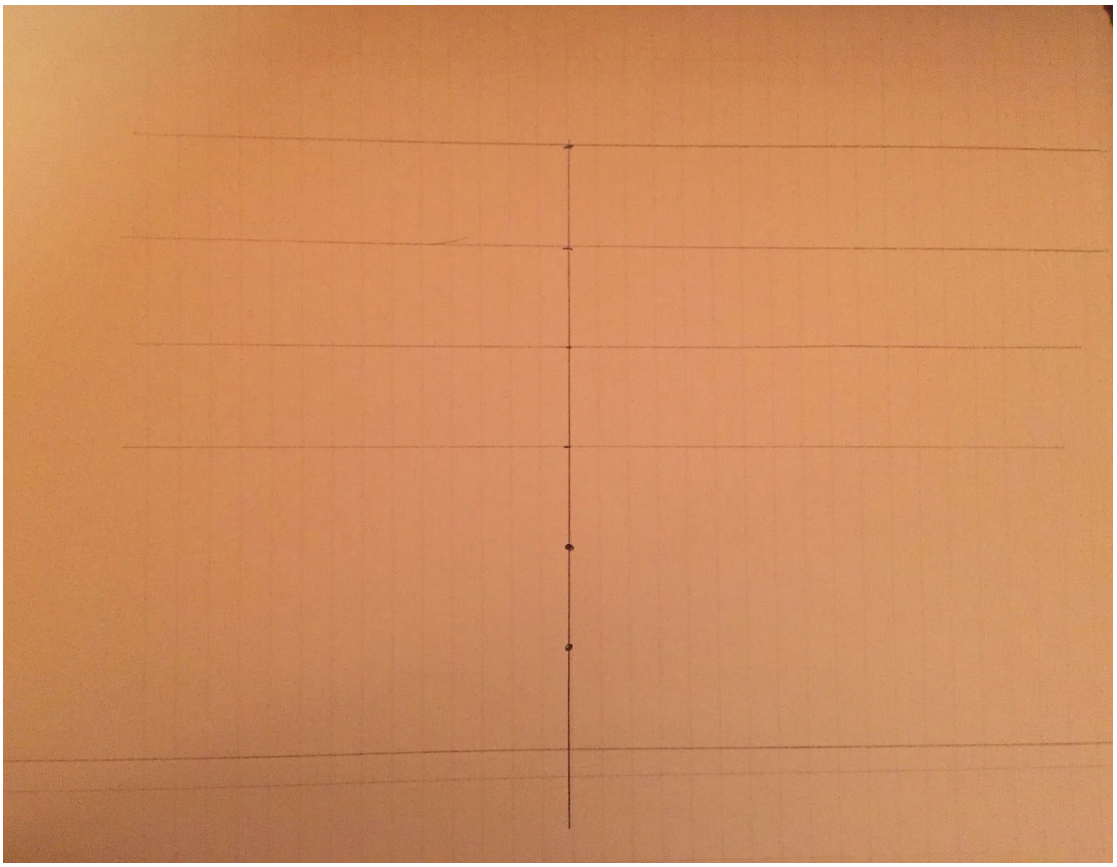
Graphic organizer: Describing wheel
Check-in for parabolas
Check-in for circles

Content Notes:

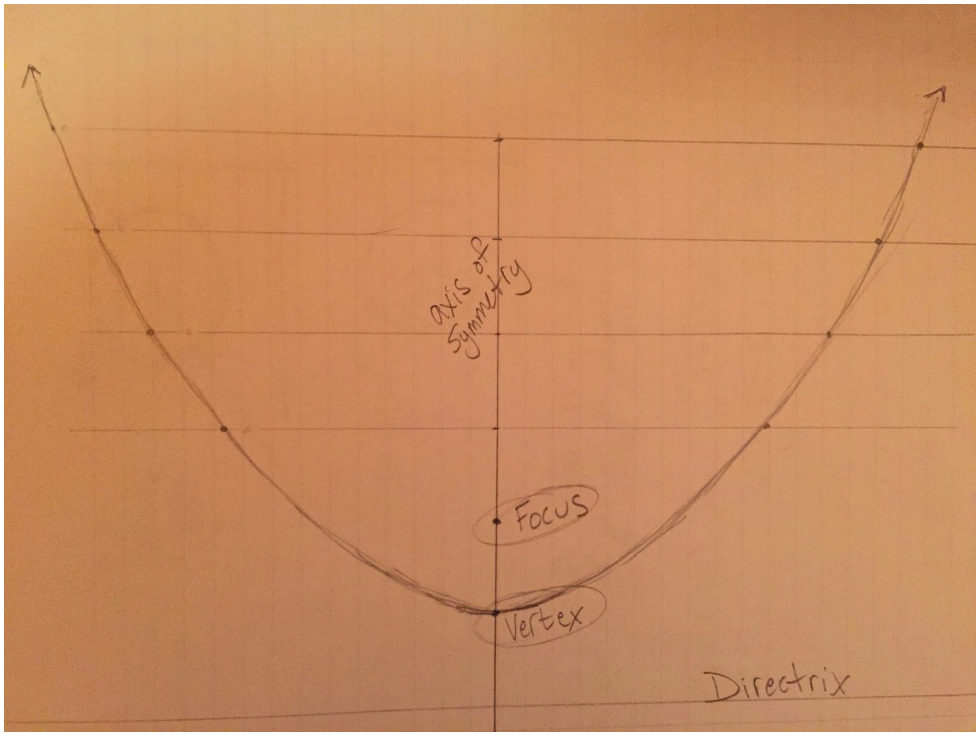
Parabola hook:



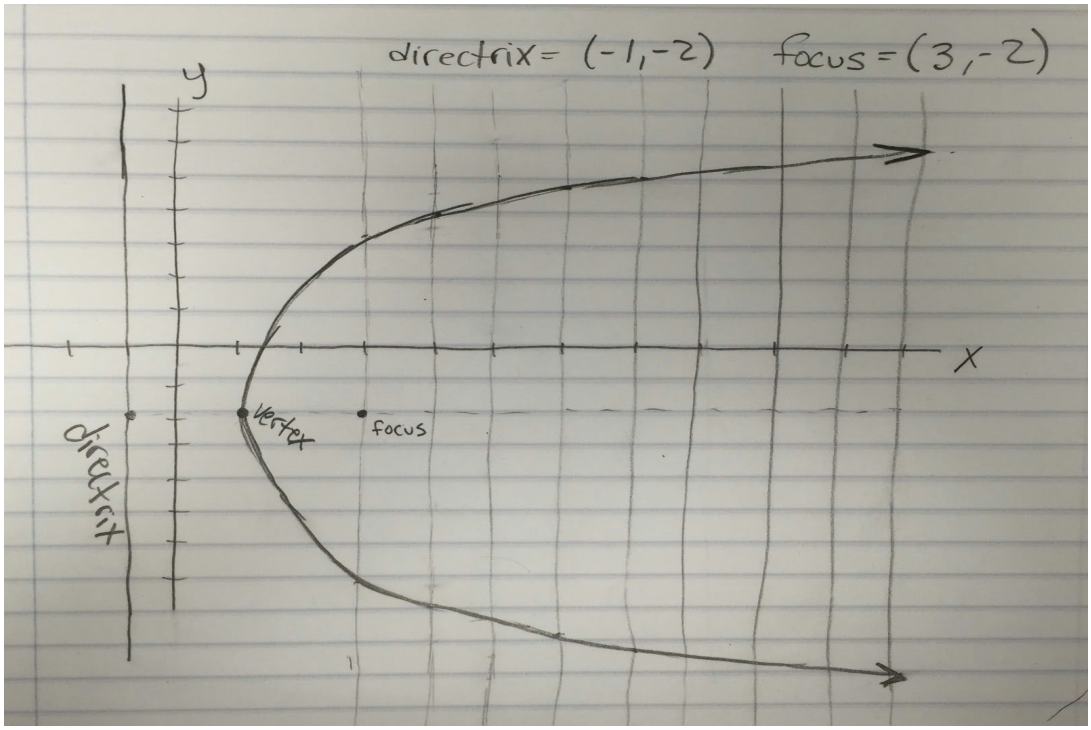
Example 1. First step for creating a parabola



Example 1. Following the instructions in the teaching and learning sequence, this is what comes next.

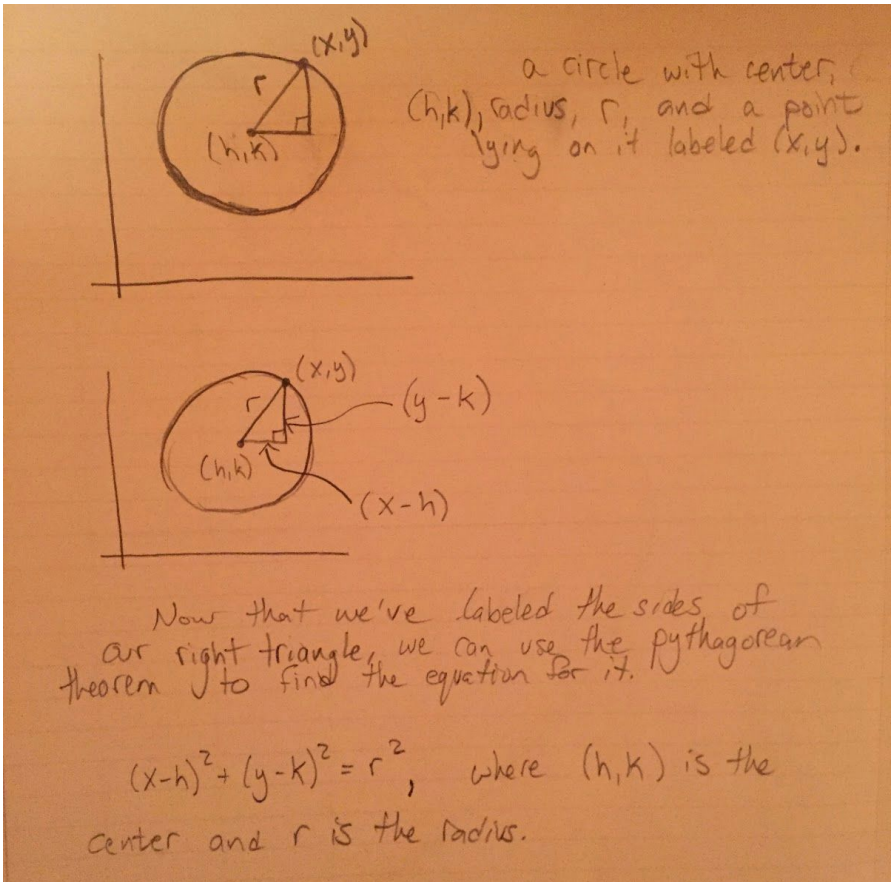


Example 2:

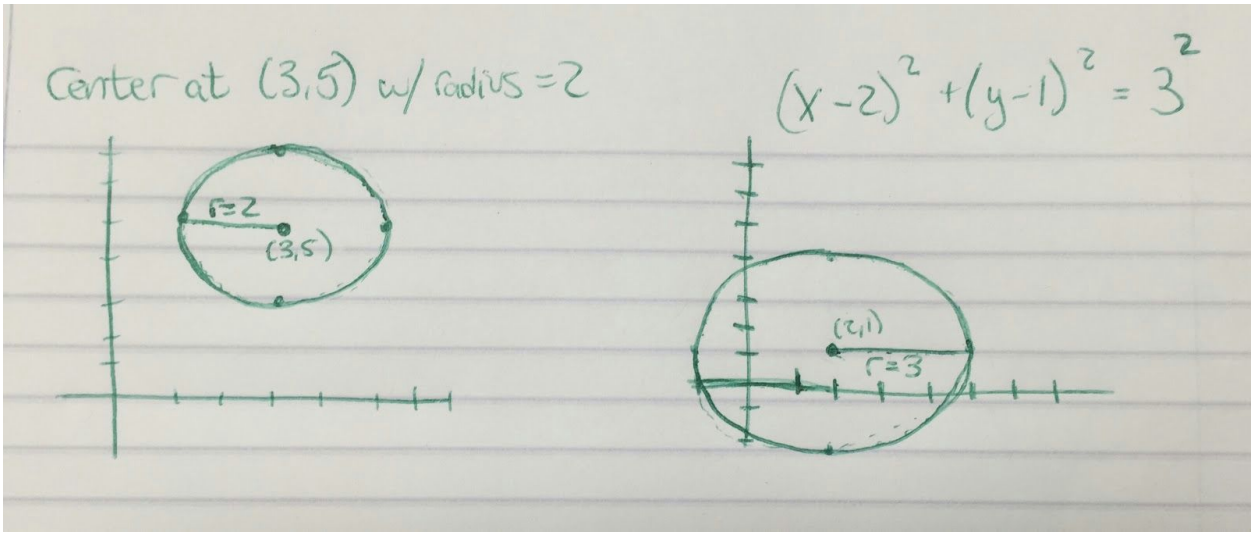


Example 3:

The process for creating the equation for a circle.



Example 4:

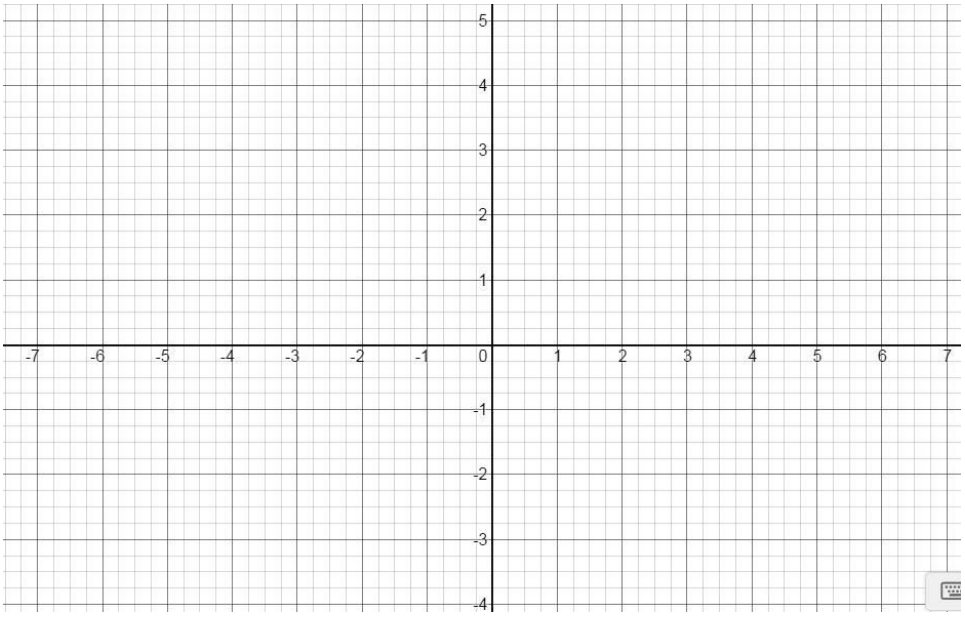


Check-in

Name: Date: Class:

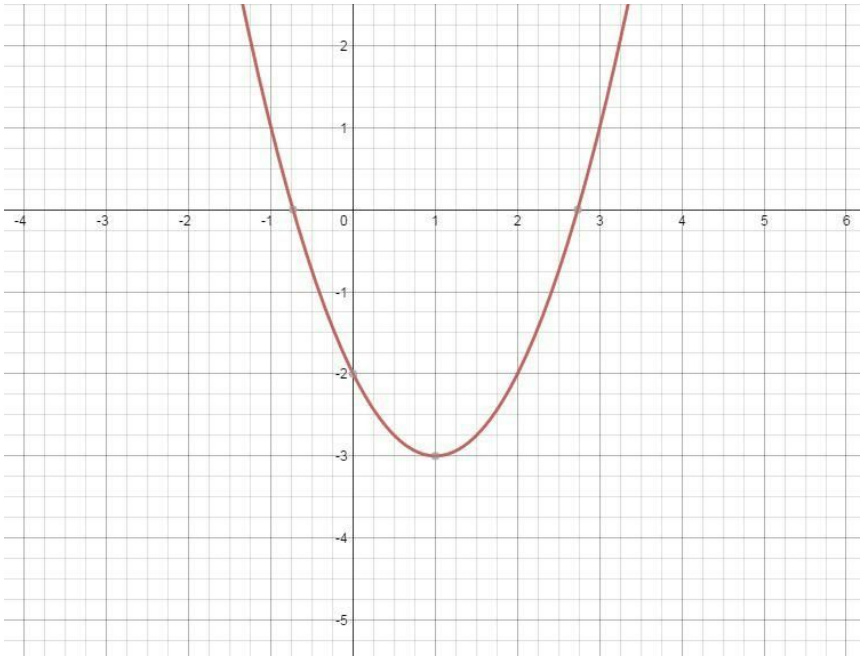
Construct a parabola using the following information:

Directrix: y=2, focus: (1,3)



Given the following parabola, identify the following:

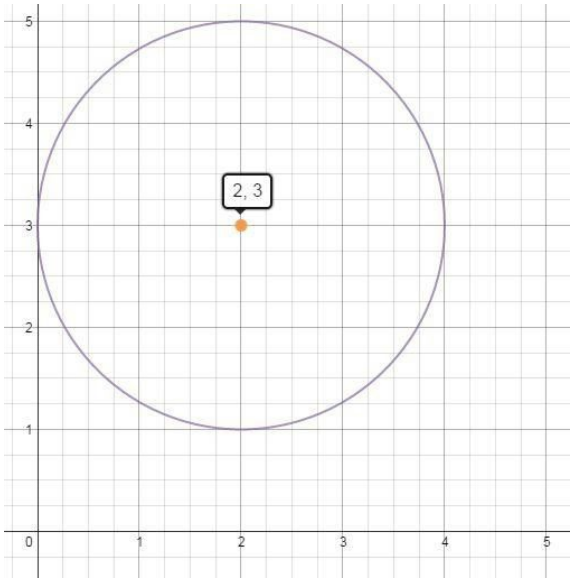
Focus: Axis of symmetry: Directrix: Vertex:



Check-in

Name: Date: Class:

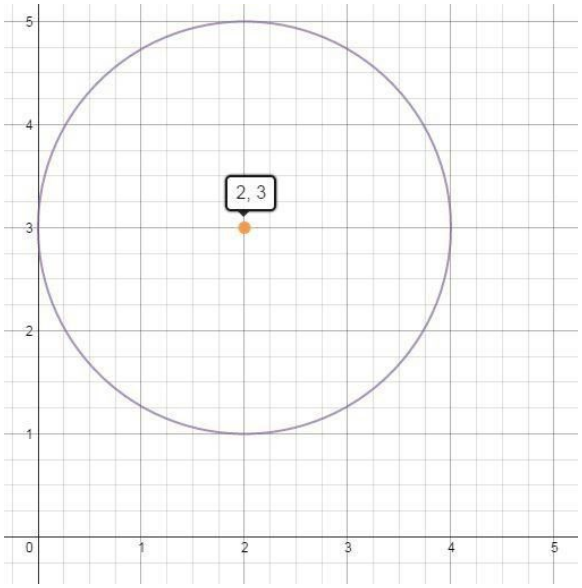
Using the information given and the Pythagorean theorem, find the equation of the circle:



Check-in

Name: Date: Class:

Using the information given and the Pythagorean theorem, find the equation of the circle:



UNIVERSITY OF MAINE AT FARMINGTON
COLLEGE OF EDUCATION, HEALTH AND REHABILITATION

LESSON PLAN FORMAT
EDU 361 Secondary/Middle Math Methods

Teacher's Name: Sean Cabaniss **Lesson #:** 2
Grade Level: 10 **Numbers of Days:** 3

Topic: Completing the square and creating an equation for a parabola.
Room Arrangement: The room will be set up in a parabola. A) because it helps with engagement and room cooperation and B) because it would fit right into the lesson with parabolas.

PART I

Objectives:
Students will understand that:

- completing the square is used with each of the conic sections, but we will start with parabolas and circles, and later apply them to ellipses and hyperbolas.

Students will know:

- how to create an equation given any parabola, and complete the square with both parabolas and circles.

Students will be able to do:

- recognize when to complete the square
- consider the differences in the conic sections and how completing the square differs between them.

Product: Prezi--students will create a Prezi that consists of all the components of completing the square and creating equations for parabolas. They will give very detailed explanations and be comfortable enough to present the content to people who have never seen it before.

Common Core State Standards (CCSS) Alignment
(List Content Area, Grade Level, Domain(s), Standard(s), and Cluster(s))

Common Core State Standards (CCSS) Alignment

Content Area: Geometry

Grade Level: High School

Domain: Expressing Geometric Properties with Equations

Cluster: Translate between the geometric description and the equation for a conic section

Standard(s):

- Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.
- Derive the equation of a parabola given a focus and directrix.
- In addition… Introduce ellipses and hyperbolas

Which CCSS Mathematical Practice(s) will be addressed (list the number and the description):

2. Reason abstractly and quantitatively
8. Look for and express regularity in repeated reasoning

Rationale: (for both the CCSS standards and the practice(s))

Student will have many times to practice the skills of completing the square in this lesson and, in addition, will be able to derive an equation for any parabola given the focus and directrix. Through multiple formative assessments and a summative Prezi, they will have ample time to practice and get comfortable with the the content. The mathematical practices two and eight will fit particularly well in this lesson because both completing the square and deriving the formula for any parabola is an abstract concept that is further broken down into specific cases. In addition, they will be able to find patterns in the equations and develop a deeper sense of reasoning for working with parabolas and circles.

Assessments

Pre-Assessment: (just for lesson 1)

Formative (Assessment for Learning)

Section I – checking for understanding during instruction

Rally Coach--students will be in pairs and will be responsible for the following roles: The coach will need to tell their partner how to complete a problem. The partner, or scribe, can only write what the coach tells him/her to write. Once a problem is completed, the rolls will switch.

Section II – timely feedback for product (self, peer, teacher)

Students will use a checklist to make sure they have all the essential elements for their summative assessments before they get too in depth into their Prezis.

After they reflect on their own, they will get in groups of two and share their drafts with their partners. Partners will write down constructive criticism to help improve their summative assessments.

Following this, when students have started their summative assessments, I will be able to check with them individually to make sure they are on the right track. The prezis will be done in class, so I will be able to frequently check with them to make sure progress is going well.

Summative (Assessment of Learning): (Description of Product)

Prezi--students will construct a Prezi that demonstrates their knowledge of parabolas and circles using the knowledge they already have of completing the square. They should feel comforatble with using the technology so that they could present it to anyone.

Integration
Technology and SAMR Level

Desmos--Technology at the augmentation level that allows for the intuitive creation of graphs and even has the capability of animation. This tool will be used during instruction and the students will be able to utilize it themselves to further their understanding. They will be able to check that the equation they started with is the same as the one they ended with after completing the square by graphing both and seeing if they are the same graph.

Prezi--This is a technology at the Modification level, because not only is it an excellent way to present information, but it also can be viewed at any time with a link. It has interactive components that set it apart and make it far better than a typical poster.

Other Content Areas:

English: Students will be asked to voice their opinions on how they think to complete the square first for the rectangular picture of a standard quadratic, and then for a circle given their previous knowledge. For some students writing this down may be more beneficial for sharing with their peers and the class so they will be asked to write it down to aid their thoughts and strategies.

Instructional Model (Select one: direct instruction, inquiry training, concept attainment, learning cycle, concept of formation, unguided inquiry, cooperative learning)

Learning cycles with a hint of inquiry training. The instructional strategies and templates were taken from "K-12 Classroom Teaching--A Primer for New Professionals", by Andrea M. Guillaume.

Rationale:

Learning cycles will help students to relate the content to the real world, and more specifically, it will let them explore the topic as well as develop concepts through multiple means of instruction. They will then have the opportunity to apply what they learned and prove that they are proficient at what they practiced. Throughout the lesson students will have the opportunity to consider concepts before they are taught to them. This will help them to think abstractly before they see it. Critical thinking is an important skill, and having students think prior to instruction will help develop that skill.

Groupings

Section I - Graphic Organizer & Cooperative Learning used during instruction

Students will use the 'Ice Cream Cone' to strategically position their thoughts if it is helpful to them. The cooperative learning model will be the same as the checking for understanding in the lesson, which is the checking for understanding, Rally Coach.

Section II – Groups and Roles for Product

Students will be responsible for equally distributing responsibilities for the Prezi. They will be in groups of two so there should be plenty for each student to do. They will end up doing a short feedback questionnaire for me to get a good idea of how much effort was put in by each student.

Differentiated Instruction

Motivational Strategy (Tell which Posamentier and Krulik motivational strategy will be used and credit them. Describe how you are using it and why.) *NOTE: Use a variety across the unit*

I will have students brainstorm in groups of two all of the different ways parabolas can represent real world scenarios and architecture. After they have had five minutes to brainstorm they will share with the class. The group that has the most original ideas will win, meaning if two groups share an idea it becomes nullified and no points will be awarded to any group for that idea. This

will present a challenge to the students who will hopefully start to come up with stellar ideas that we will then share amongst everyone in the class.

Motivational strategies were taken from "The Art of Motivating Students--For Mathematics Instruction" written by Alfred S, Posamentier and Stephen Krulik.

Multiple Intelligences Strategies *Note: Address at least six. Delete any you do not address.*
Logical: Students will be given the opportunity to think their way through topics before instruction occurs. This will allow them to let their mind explore different possibilities before they get direct instruction.
Verbal: Students will have the opportunity to explain how they arrived at specific answers, and they will also get to hear my explanations of direct instruction in addition to the written out examples.
Visual: Students will be able to look at graphs either drawn on the board or created using technology.
Intrapersonal: Students will be given plenty of opportunities to work alone on problems. They will be able to work on specific examples and work their way through problems before working with others.
Interpersonal: Through the use of Rally Coach, students will be able to work with one another to complete practice problems to get more comfortable with the material.

Modifications/Accommodations
From IEP's (Individual Education Plan), 504's, ELLIDEP (English Language Learning Instructional Delivery Education Plan) *I will review student's IEP, 504 or ELLIDEP and make appropriate modifications and accommodations.*

Plan for students who are missing pre-requisite skill(s):
Although tiering can work, I do not want some students drastically ahead of others. Therefore missing pre-requisite skills will be taught as they become relevant in the class. Students who I feel grasp concepts well will be strategically placed in the room near Evangeline, Rabiu, and Mutumbo, who are lacking pre-requisite skills. These three students, and others who are struggling, will be encouraged to advocate for themselves so they can get the most out of their learning. They will do this by either asking me or a peer who may be able to help them.

Plan for accommodating Special Education:
Both Mutumbo and Rob are receiving special education services and have an IEP that outlines modifications and accommodations that are specific to their learning. They are almost entirely immersed in my classroom, but will have a resource room with additional attention if they need

it. However, I will provide as much support as I need to, and their peers will be able to assume leadership roles to assist them as well.

Plan for accommodating English Language Learners:
Each lesson will be made so that there are plenty of visuals and Rusney, Gisele, and Krystopher will be able to work hands on to get a grasp on the concepts. Conversation about parabolas and circles will happen, although there will be numerous opportunities to construct and build which leaves time for one on one attention if needed.

Plan for accommodating absent students:
Through the use of my Weebly webpage, I will be able to update it and keep a detailed agenda of what was covered in class. Students will still be responsible for coming to see me to get the required papers they missed. In addition, students will have their success teams that they can always fall back on to check with to make sure they have all the necessary information.

Extensions (tiering, gifted students, the students who already know it, etc…)
Sam, Damien, Grace, and Gisele are all student who perform above and beyond in the math classroom. These students will have the opportunity to push themselves to the next level with the construction of other geometric shapes graphically. They may be asked, after an individual meeting with the student, to do some independent research to further their understanding of specific topics. These students may also be used as an aid to me to assist students who are struggling with the material.

Materials, Resources and Technology
List all the items you need for the lesson, including handouts.

Graphic organizer
Check-in for previous classes

Source for Lesson Plan and Research
List all URLs and describe.

How to create parabolas using focus and directrix:
http://www.purplemath.com/modules/parabola3.htm

How to create a specific equation for a parabola using the focus and directrix:
https://www.khanacademy.org/math/algebra2/conics_precalc/parabolas_precalc/v/using-the-focu

s-and-directrix-to-find-the-equation-of-a-parabola

Some circle equation problems:
http://cdn.kutasoftware.com/Worksheets/Geo/11-Equations%20of%20Circles.pdf

Completing the square for circles:
https://www.mathsisfun.com/algebra/circle-equations.html

PART II: *Note: The purpose of Part II is to take everything from Part I and make it come alive with details in such a way that you can easily teach from it but also a substitute unfamiliar with your content area could carry out the lesson.*

Day 1 (80 min):
Cool random math (5 min)
Previous class check in (5 min)
Engage with real world parabolic examples (10 min)
Direct instruction (a look back at parabolas): creating a function from the given information (20 min)
Consider different parabolas (10 min)
Practice individually (10 min)
Rally Coach (15 min)
Introduction to Prezi (5 min)

Day 2 (80 min)
Cool random math (5 min)
Previous class check-in (5 min)
Going from directrix form to standard form for quadratics (10 min)
Prompt questioning for completing the square for parabolas (10 min)
Direct instruction on completing the square (20 min)
Individual practice with problems (20 min)
Meet about Prezi (10 minutes)

Day 3 (80 min):
Cool random math (5 min)
Previous class check-in (5 min)
Student inquiry for possibilities with completing the square for circles (10 min)
Direct instruction for completing the square (10 min)
Practice individually (10 min)

Rally Coach (30 min)
Students meet to talk about Prezi (10 min)

Teaching and Learning Sequence

Day 1:

(5 min) To open the class, I will show students the third and final video from 'doodling in math' and it will pull all of the fibonacci numbers together. Students really enjoy this concept.

(5 min) Then students will have a check-in to test their knowledge of what they learned in the previous class on circles to keep their knowledge fresh.

Open
Engage:
(10 minutes) Students will get into groups of four and consider a real world phenomenon that might represent a parabola. For example, they might discuss how when you kick a soccer ball up in the air the height vs. time graph could make a parabolic graph. Another example might be a position vs. time graph of a roller coaster. Regardless, students will get thinking about different parabolic functions, and then I will show them **Example 1** which consists of a bunch of real world parabolas. The students who came up with the most original ideas win. If more than one group shares the same example it becomes nullified.

Body
Explore:
(20 min) Now, using direct instruction, we will look at creating an equation for a parabola given the focus and directrix. **Example 2** represents how to create a parabola given a specific focus of (0,1) and directrix of y= -3. Following this, I will show the students in **Example 3** how to create an equation for a parabola given a general focus and a general directrix. This will get them thinking abstractly which will help prepare them for college level mathematics.

Develop:
(10 min) Following the general form for creating the equation for any parabola (that is defined by a function) I will have students consider what the general form for creating a parabola that is flipped about the y=x axis (a parabola on its side).

(10 min) Now students will do the following problems by way of construction via the distance formula to test their skills before doing rally coach to even further their knowledge: Focus = (1,2), directrix: y = 4, and focus = (-2,3), directrix: y = -5

(15 min) Following the practice problems, students will get into groups of two and each create their own reasonable focus and directrix for their partner to do. Their partner will need to tell them how to complete the problem and they can only write what their partner tells them to do. This will ensure that they truly understand the material. There can be some tiering here, because some students who are really struggling can have their partner give them small hints to guide them along the process.

(5 min) Following this activity students find a new partner to create a prezi with, and they will establish a plan for how they want to do it and when they want to get it done.

Close

Apply:

For their math mission, students will select two of the parabolas on graphs and find the equation that they make. They will have to find the equation by selecting a focus and directrix for each graph and then check their answer on Desmos. If the graph the test on Desmos is not correct, they will need to alter their focus and directrix and, hopefully, they will start to develop a feel for where the directrix and focus will need to go depending on the steepness or flatness of the parabola.

Day 2:

(5 min) Cool random math: This is a quick video that shows an additional artistic component to the fibonacci sequence. It is very neat and continues to get students thinking about their surrounding and how it is full of math.

(5 min) Students will then complete their entrance ticket that will check to see what knowledge they retained from the previous class.

Open

Engage:

(5 min) First, students will walk around the room to see if they could find others who used the same real world parabolic pictures as them and compare their answers. Some good conversation should arise from this as students were asked to discover for this assignment.

Body

Explore:

(10 min) Next we will take the equations that they found and go from directrix form to vertex form for a parabola, to standard form for a parabola. While this is Geometry, there is still algebra involved and this will help them in the future for their Algebra II class.

(10 min) Students will now consider the idea of completing the square given an equation in vertex form. They will have the opportunity to look at the picture on the board given by **Example 4** and try to think of how you could possibly complete a square from a rectangle using only the same area. Would you need to add anything to make it a square? How could you cut up the rectangle to make it in the shape of a square? Students will consider these questions before instruction on completing the square.

Develop:
(20 min) Following this rich discussion, I will show the students how to complete the square for the general form of a parabola, and for a specific example; they will then go from there.
Example 6:
$y=ax^2+bx+c$
$y=x^2+3x-1$

(20 min) Then students will have the opportunity to practice on their own by taking the two problems that they did for their math mission and expanding them into standard form, then completing the square to see if they got back where they started. They will be expected to show their work on how they set up the rectangle and completed the square. The visual is very important for this concept.

Close
Apply:
(10 min) Students will now meet with their partners for their prezi and develop their strategy for completion even farther. They should focus on what they will cover in their prezi and who is completing which tasks.

Day 3:

(5 min) Cool random math: Play this game with the students… They'll love it.
MAGIC!
- Think of a number between 1-10.
- Multiply that number by 9.
- Add the two digits together.
- Subtract 5 from that number.

- A=1, B=2, C=3, D=4, E=5, etc...
- Think of a country in Europe the starts with that letter.
- Take the last letter of that country and think of an animal.
- Take the last letter of that animal and think of a color.
- Are you thinking of Orange Kangaroos in Denmark?

(5 min) Following this students will take their entrance ticket to see what they have retained from the previous class.

Open

Engage:

(10 min) Have students consider all the places they see circles in the real world. Have them brainstorm a list individually for two minutes, and then meet with a partner for three minutes to further their thinking to see when and where the see them. The team with the most original answers wins.

(5 min) Then have the students think for a couple minutes individually how they might be able to complete the square for a circle given the formula that we have. Not necessarily a picture for it, but as far as the equation is concerned, how could they complete the square in two variables? What might you need to do to the equation to make this possible?

Body

Explore:

(15 min) Now I will provide instruction for students on how to complete the square for a circle equation. There are a lot of similarities, however, the biggest component to remember is grouping each variable together to get the desired form of $(x-h)^2+(y-k)^2=r^2$. I will show how to complete the square with the following for **Example 7**: $x^2+y^2 - 4x - 6y - 4 = 0$.

(10 min) Now students will try the following problems. One is good, two is better if they have time: $16 + x^2 + y^2 - 8x - 6y = 0$… and $9 = 2y - y^2 - 6x - x^2$

Develop:

(30 min) Now students will get into groups of two and we will do Rally Coach with the following examples (each student should end up doing three problems with in-depth explanations):

$y^2 + 4x - 20 - 2y = -x^2$

$x^2 + y^2 - 2x - 4y - 4 = 0$

$x^2 + y^2 + 8x + 8y + 16 = 0$
$x^2 + y^2 + 10x - 8y + 32 = 0$
$x^2 + y^2 - 16x + 8y = 0$
$x^2 + y^2 + 8x - 12y + 27 = 0$

Each team will get a point for each problem they get correct. If everyone gets it correct, there is no need to progress. If there is a team that gets it wrong that wants to see them problem done, one of the teams who got it right can show their process on the board. This will promote student leadership in the classroom.

Close

Apply:

(10 min) Now students will get together with their partners one last time before they need to submit their Prezi.I will quickly meet with each team to make sure they are all set and ready to go.

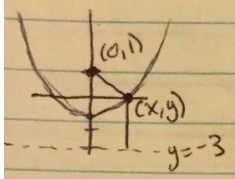
Handouts

Content Notes

Example 1: Students will examine these pictures and later use them for their math mission

Example 2:

focus $= (0,1)$ directrix $\Rightarrow y = -3$



$$\sqrt{(x-0)^2+(y-1)^2} = \sqrt{(y+3)^2}$$

$$\left(\sqrt{(x-0)^2+(y-1)^2}\right)^2 = \left(\sqrt{(y+3)^2}\right)^2$$

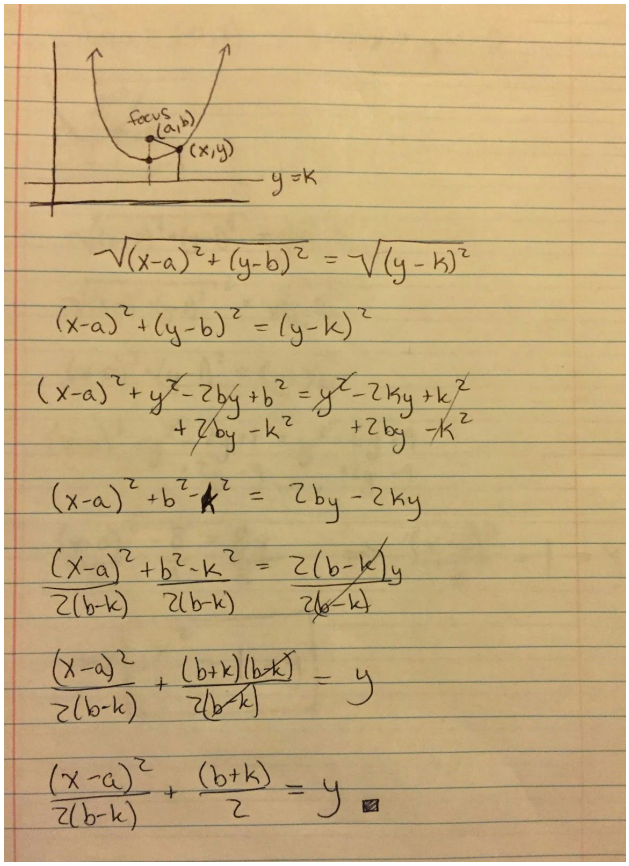
$$(x-0)^2+(y-1)^2 = (y+3)^2$$

$$(x-0)^2 + y^2 - 2y + 1 = y^2 + 6y + 9$$
$$+2y \quad -9 \qquad +2y \quad -9$$

$$\frac{(x-0)^2}{8} - \frac{8}{8} = \frac{8y}{8} \Rightarrow \frac{(x-0)^2}{8} - 1 = y$$

$$\Rightarrow \boxed{\frac{x^2}{8} - 1 = y}$$

Example 3:



$$\sqrt{(x-a)^2+(y-b)^2} = \sqrt{(y-k)^2}$$

$$(x-a)^2+(y-b)^2 = (y-k)^2$$

$$(x-a)^2+y^2-2by+b^2 = y^2-2ky+k^2$$
$$+2by-k^2 \qquad +2by-k^2$$

$$(x-a)^2+b^2-k^2 = 2by-2ky$$

$$\frac{(x-a)^2}{2(b-k)}+\frac{b^2-k^2}{2(b-k)} = \frac{2(b-k)y}{2(b-k)}$$

$$\frac{(x-a)^2}{2(b-k)}+\frac{(b+k)(b-k)}{2(b-k)} = y$$

$$\frac{(x-a)^2}{2(b-k)}+\frac{(b+k)}{2} = y \quad \blacksquare$$

Example 4:

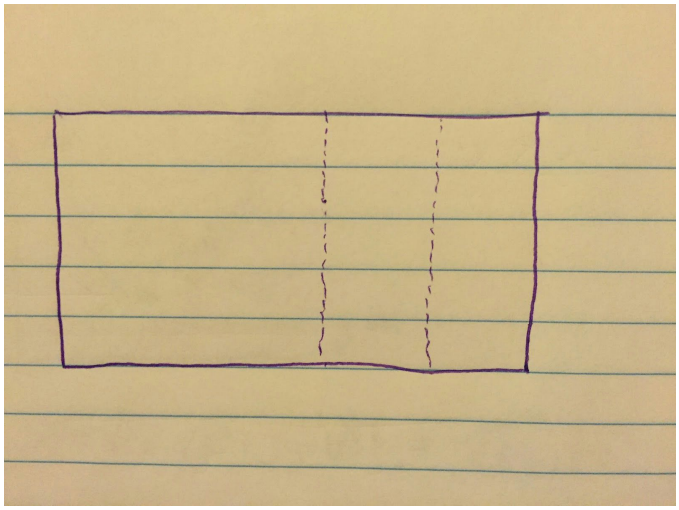
$$y = x^2+3x-1$$

$$x^2+3x-1=0 \qquad x^2+3x+\_\_\_ = 1+\_\_\_$$

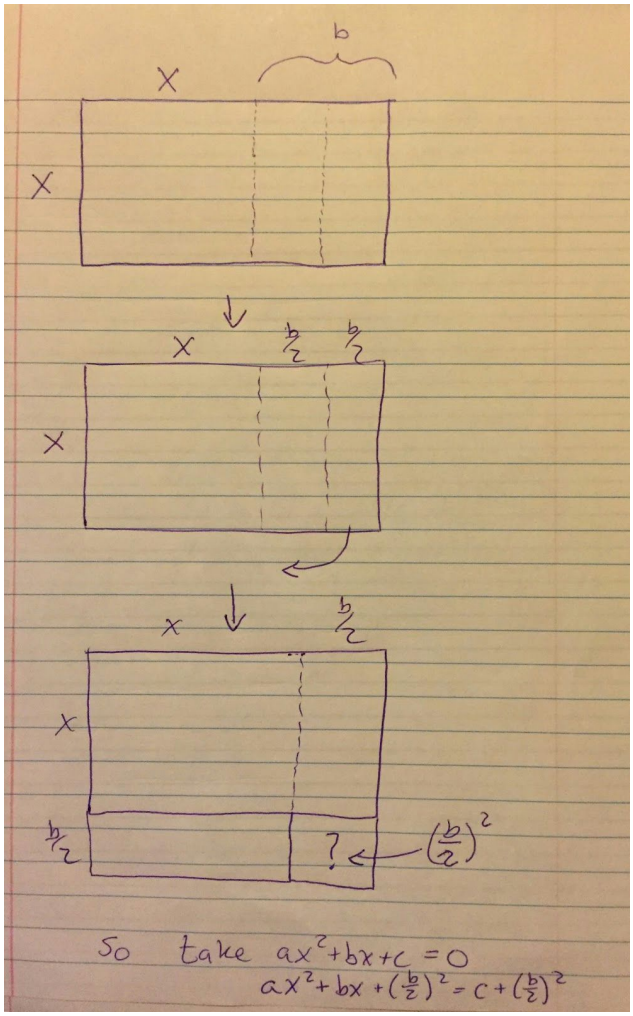
$$x^2+3x+\frac{9}{4} = 1+\frac{9}{4}$$

$$x^2+3x+\frac{9}{4} = \frac{13}{4} = \boxed{\left(x+\frac{3}{2}\right)^2 = \frac{13}{4}}$$

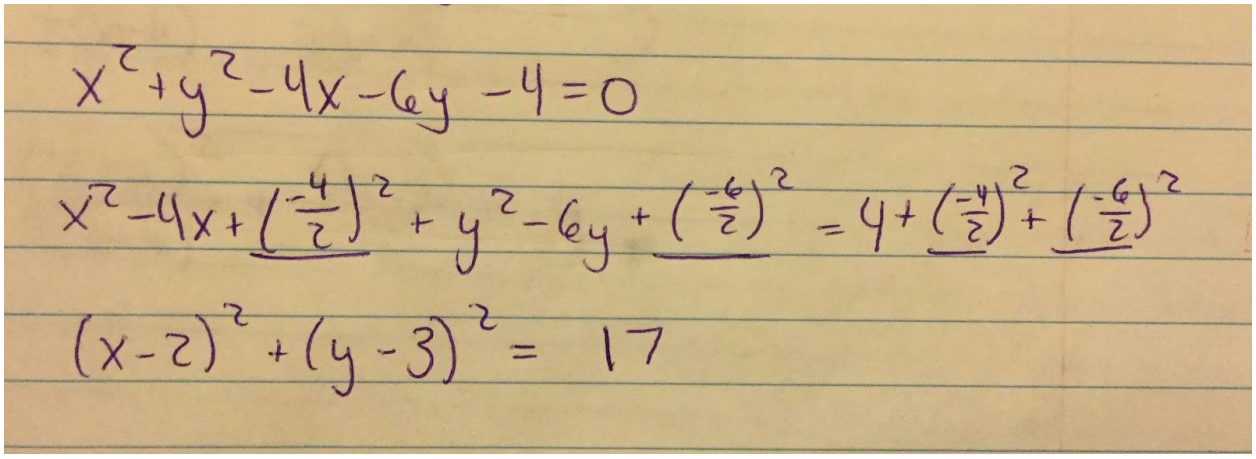
Example 5:

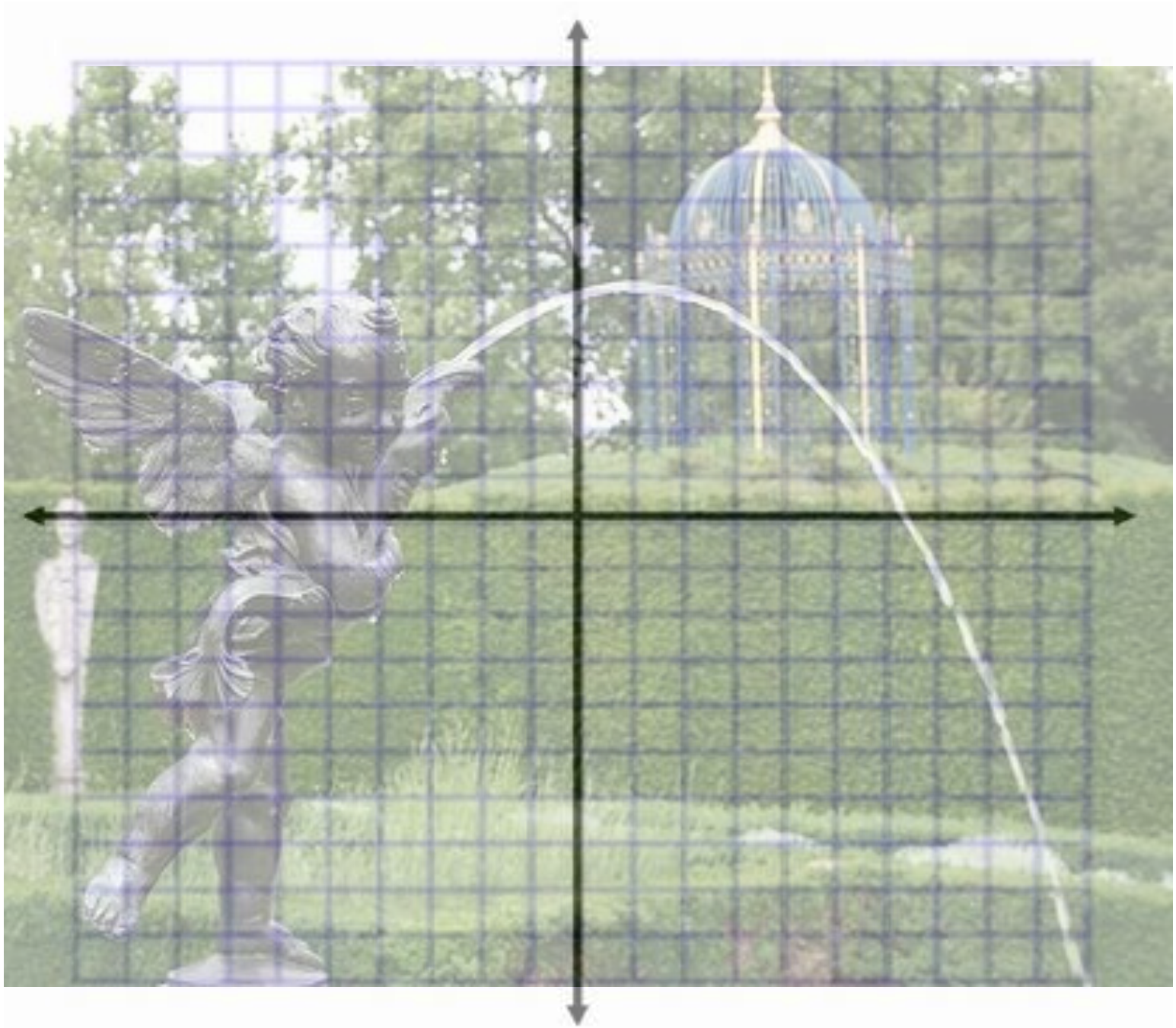


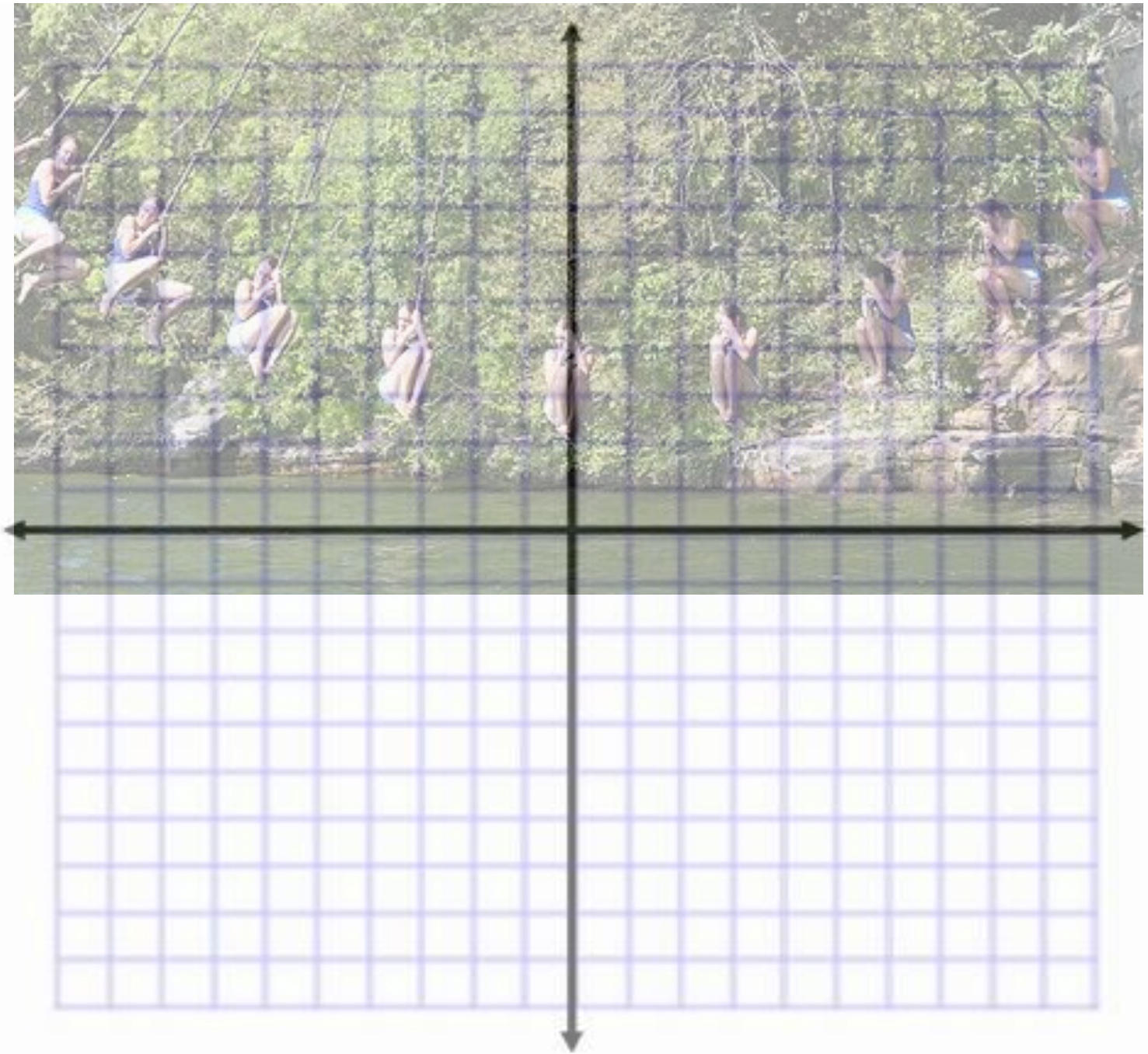
Example 6:

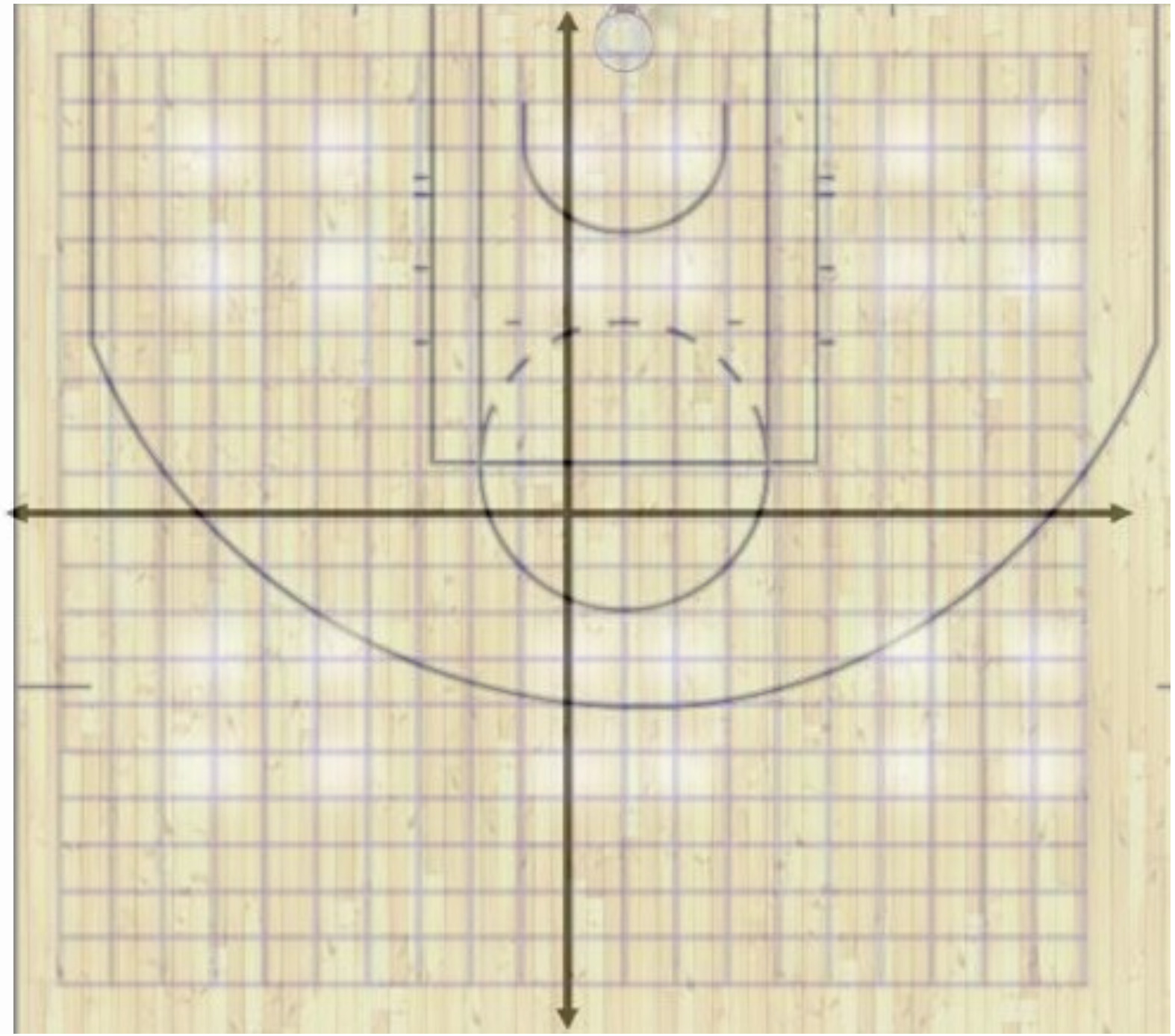


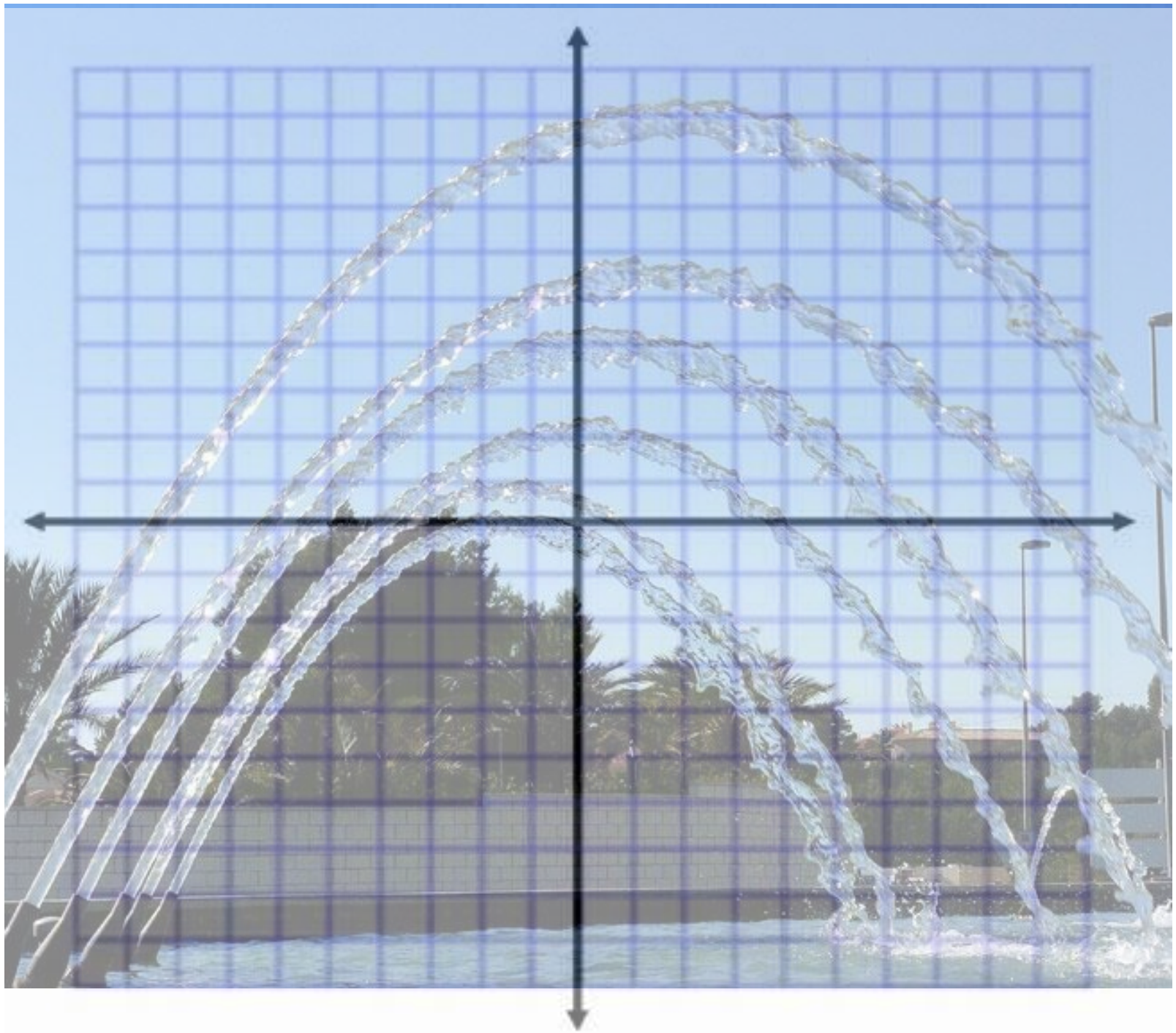
Example 7:

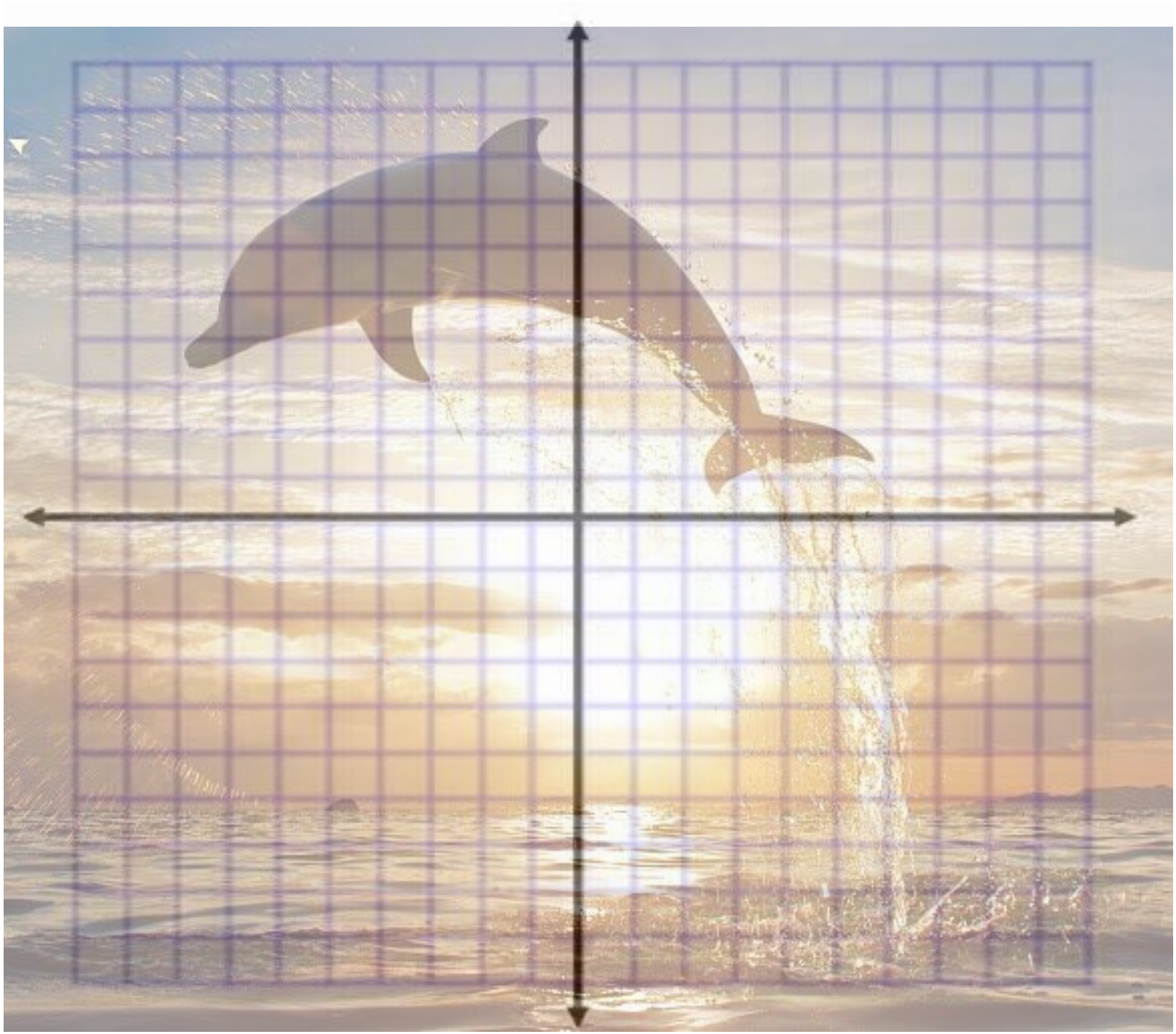

$x^2+y^2-4x-6y-4=0$
$x^2-4x+\left(\frac{-4}{2}\right)^2+y^2-6y+\left(\frac{-6}{2}\right)^2=4+\left(\frac{-4}{2}\right)^2+\left(\frac{-6}{2}\right)^2$
$(x-2)^2+(y-3)^2=17$

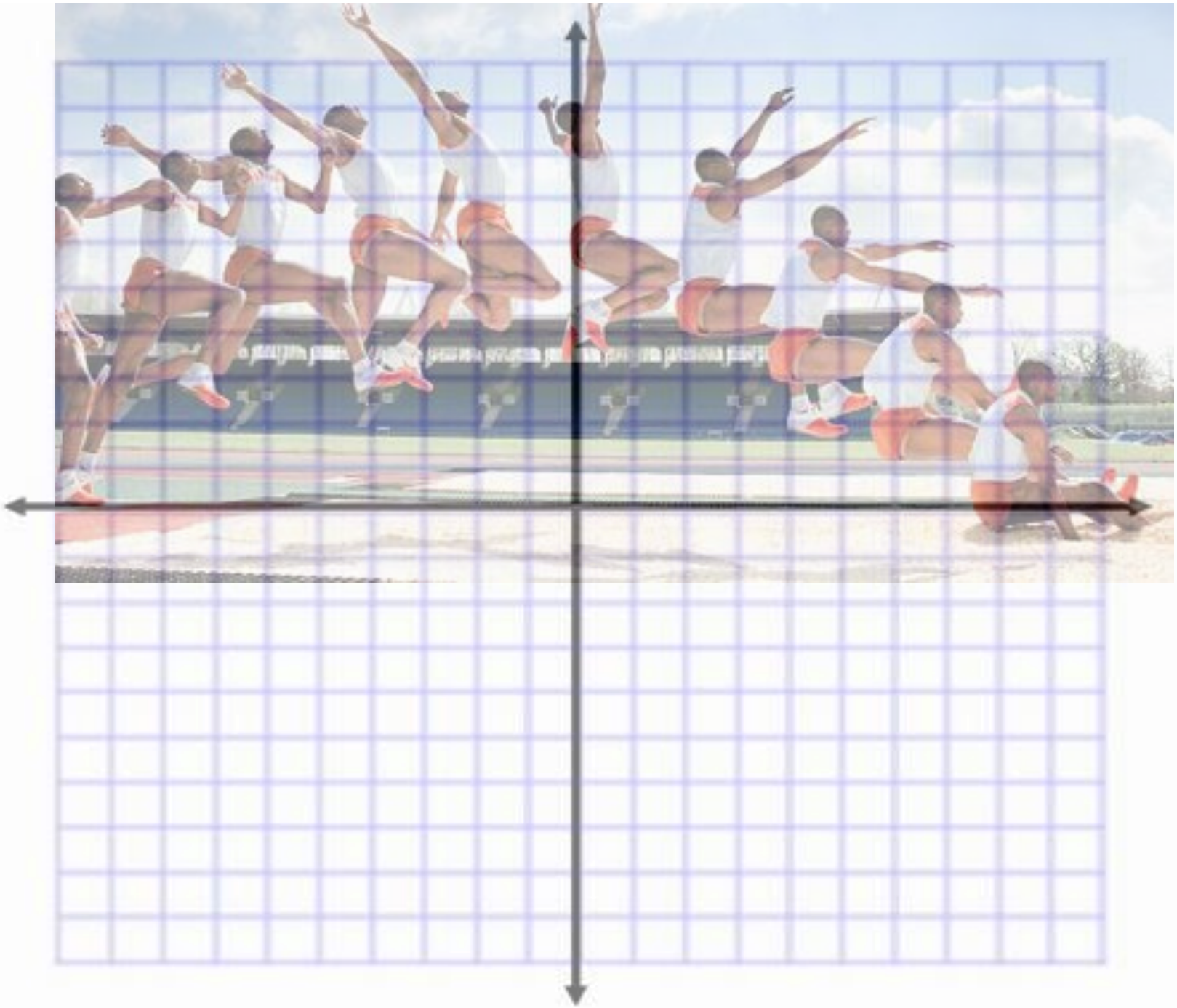


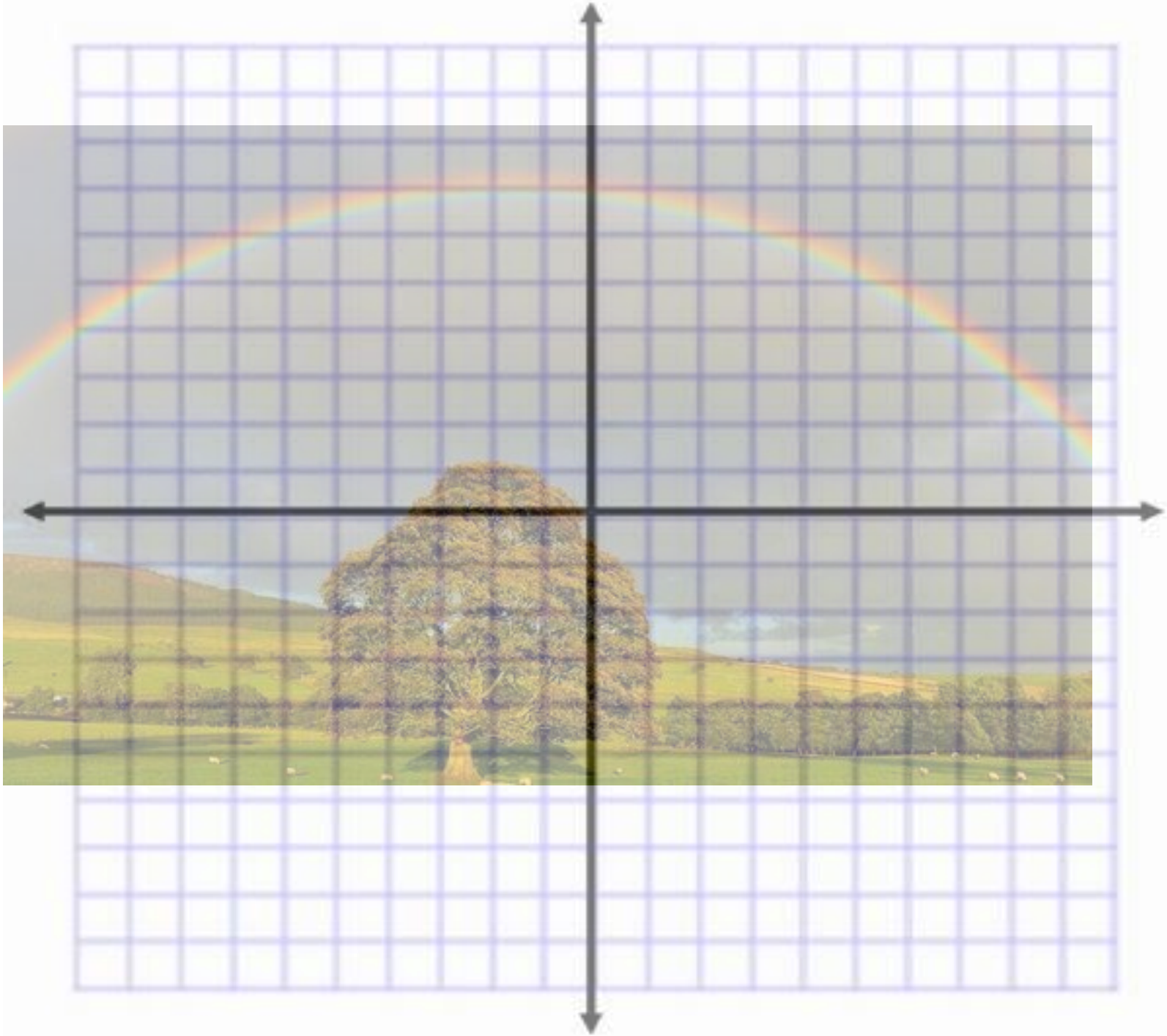


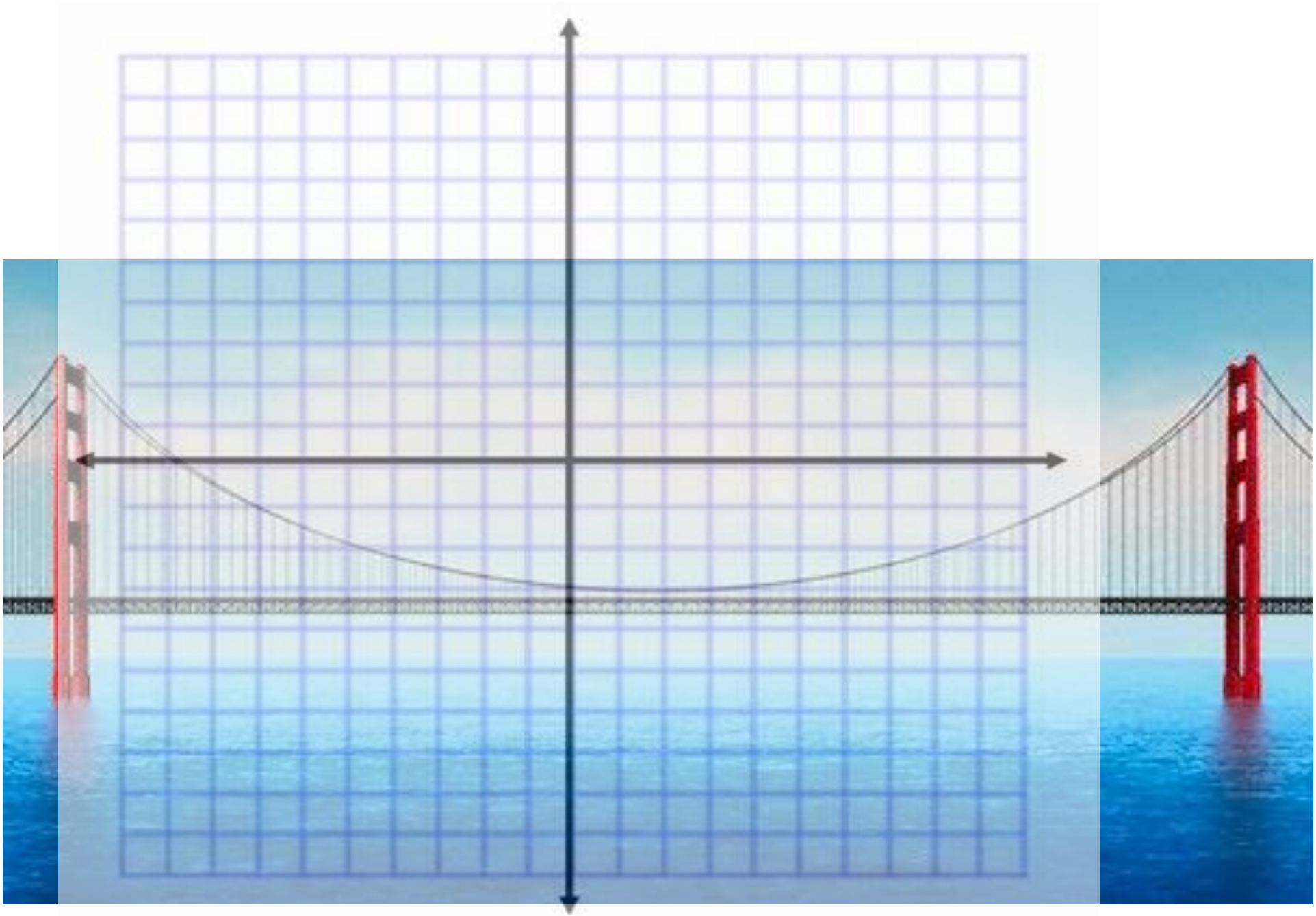


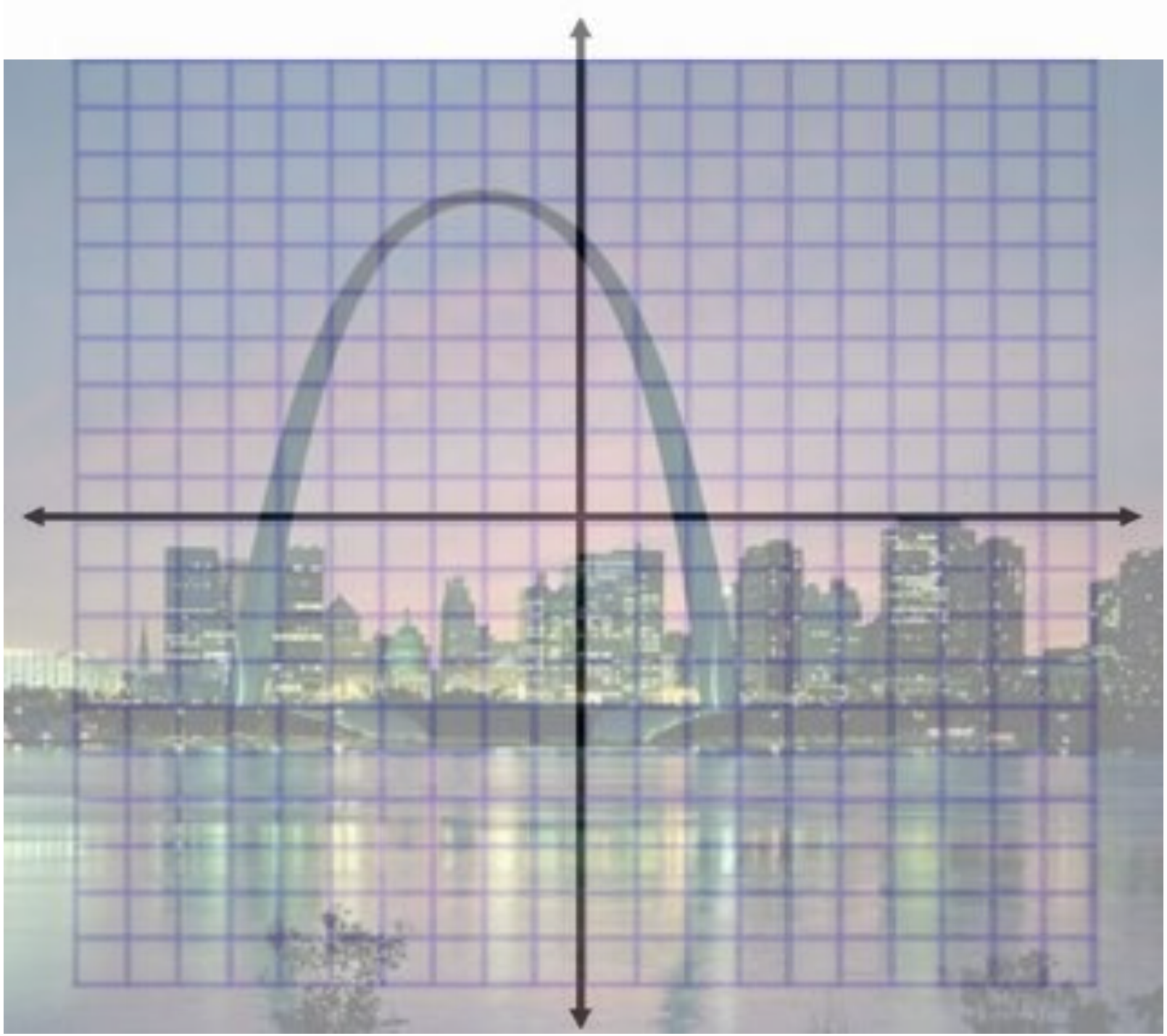


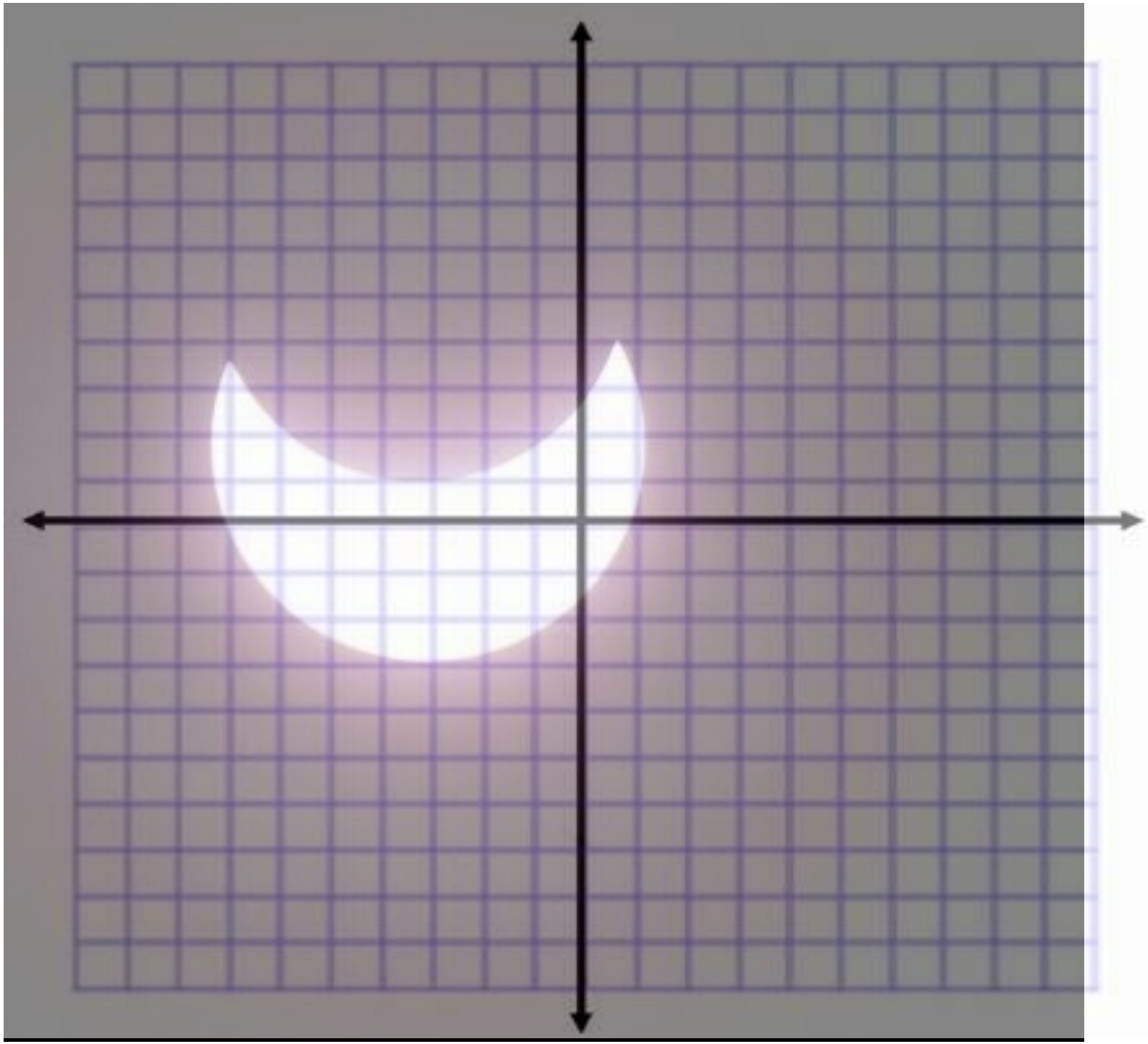


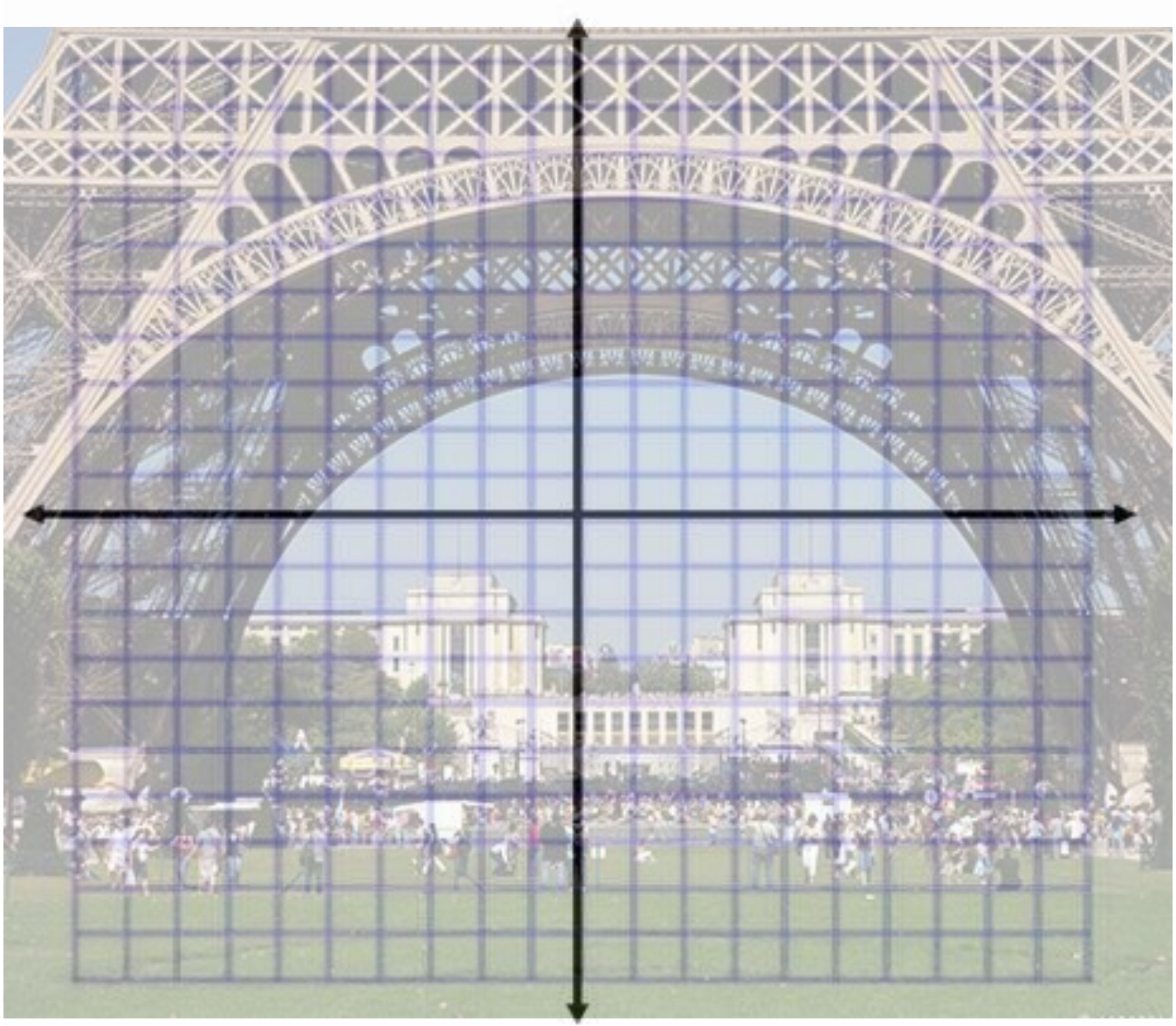


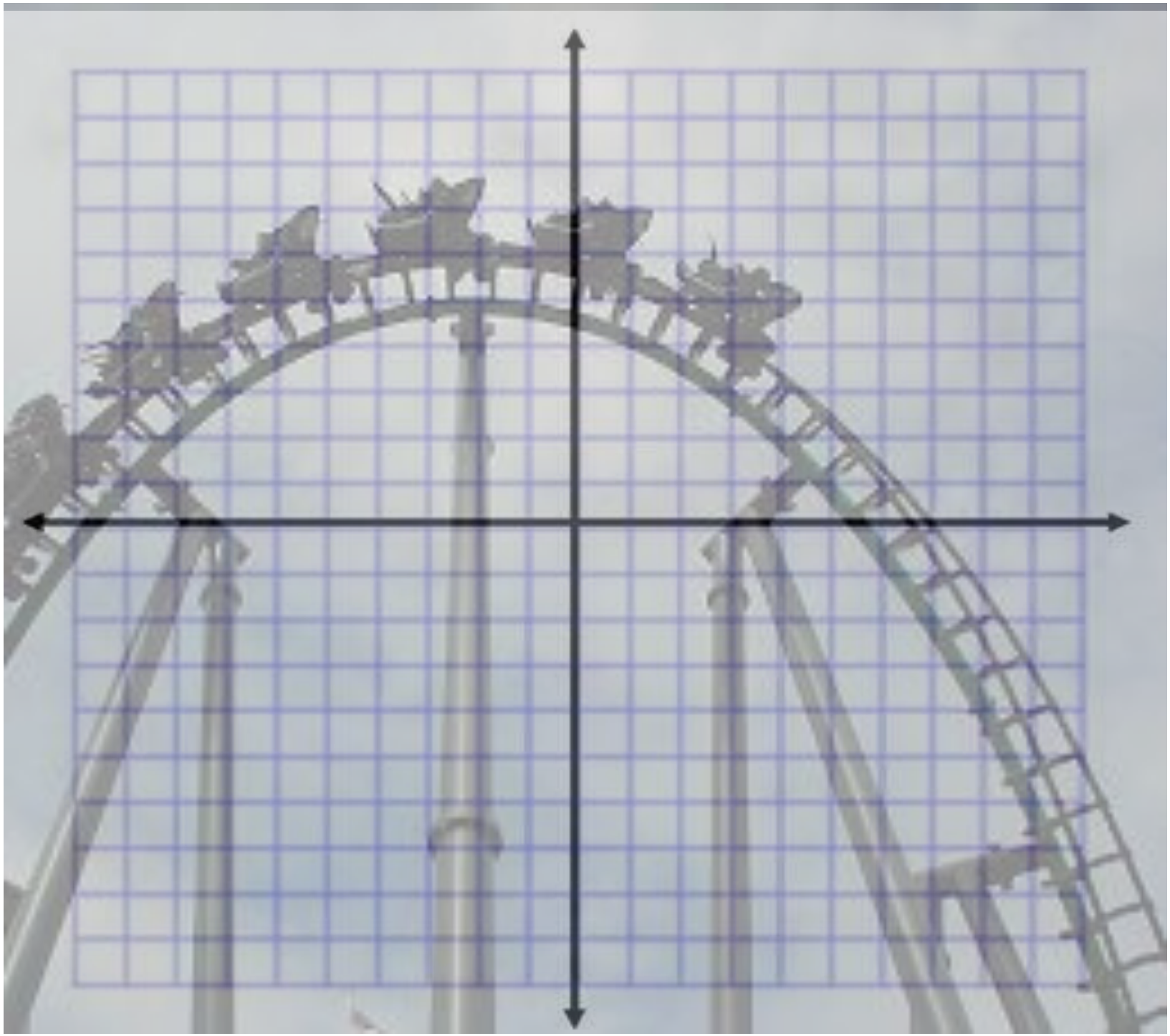


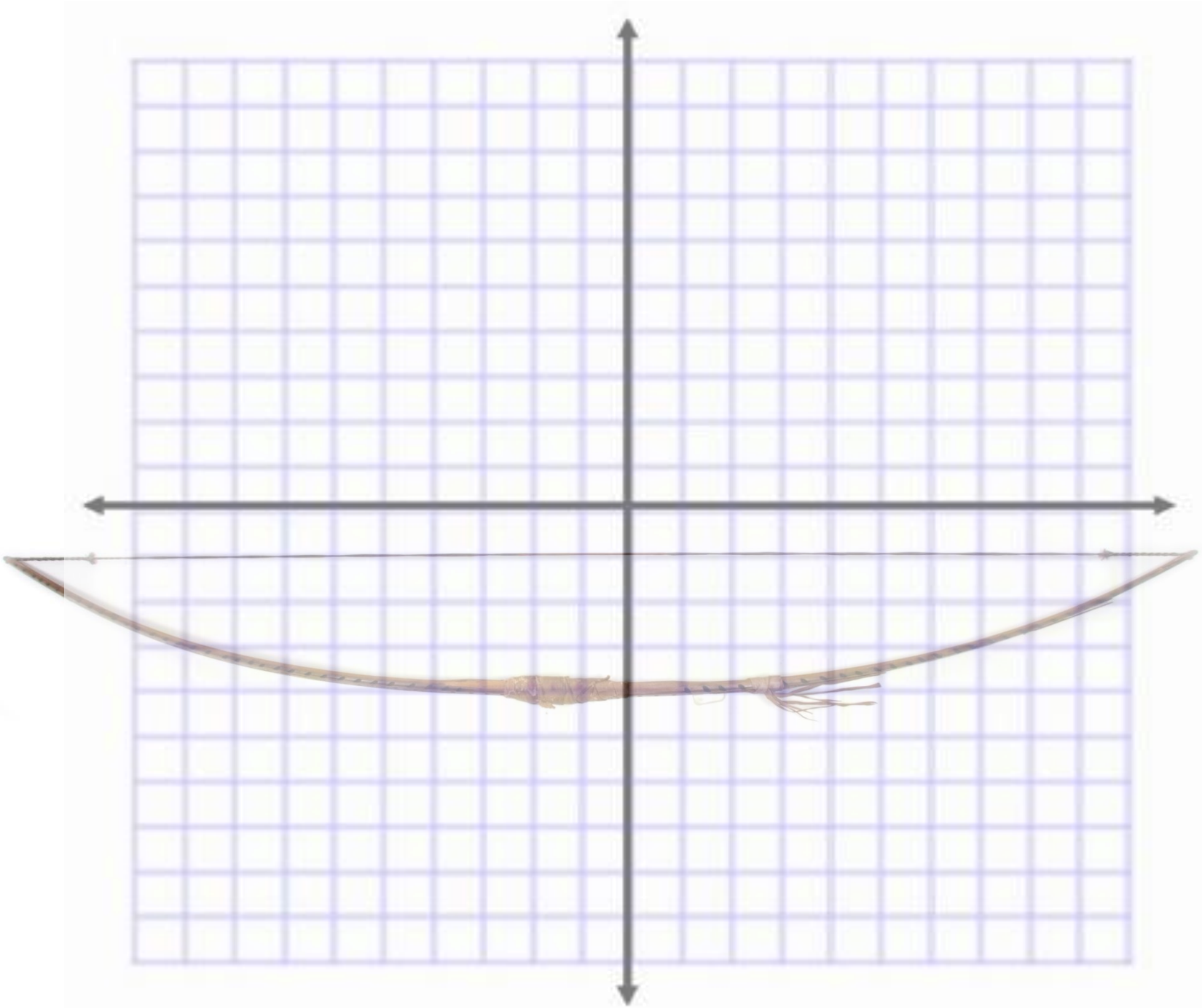


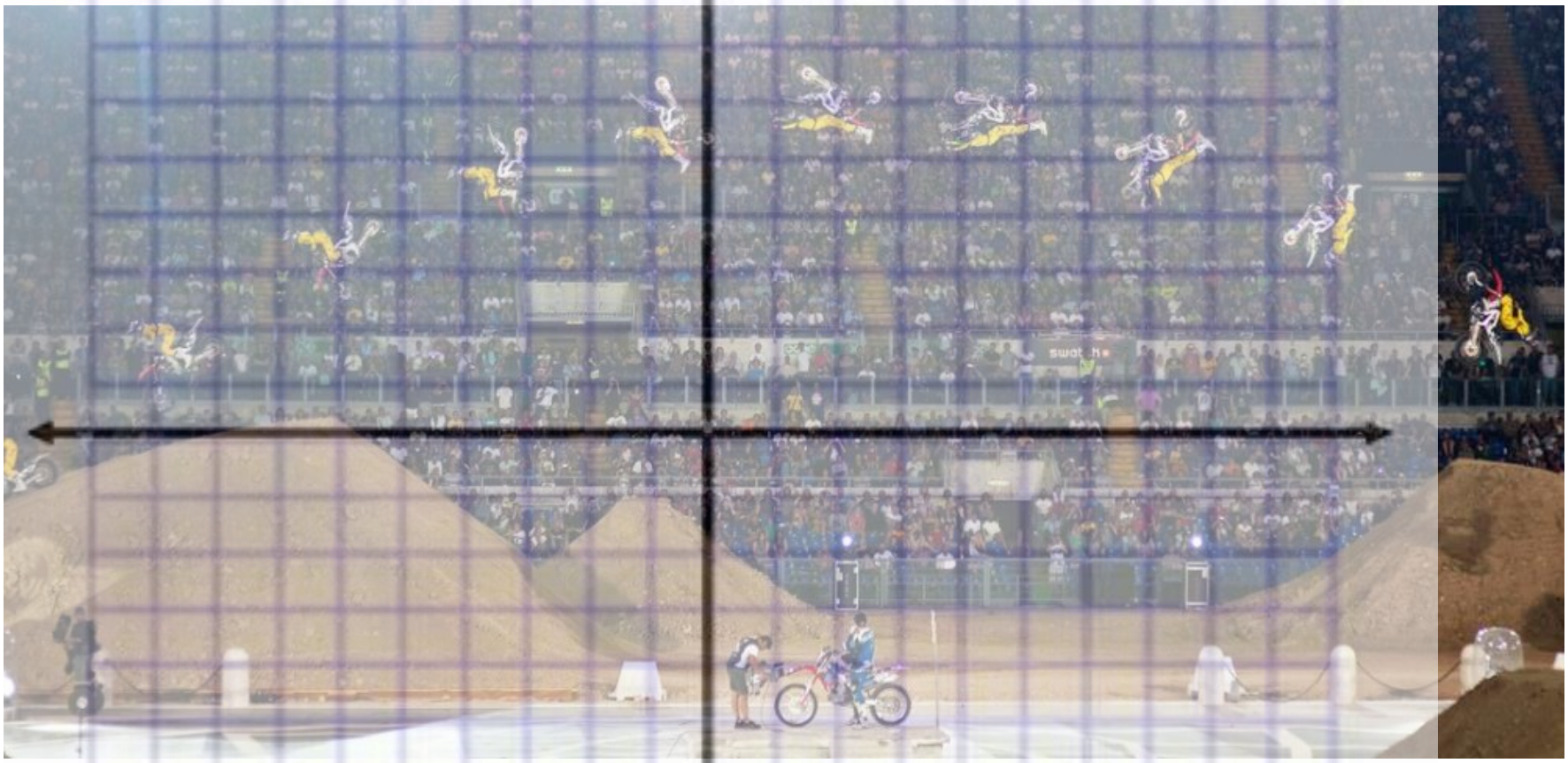


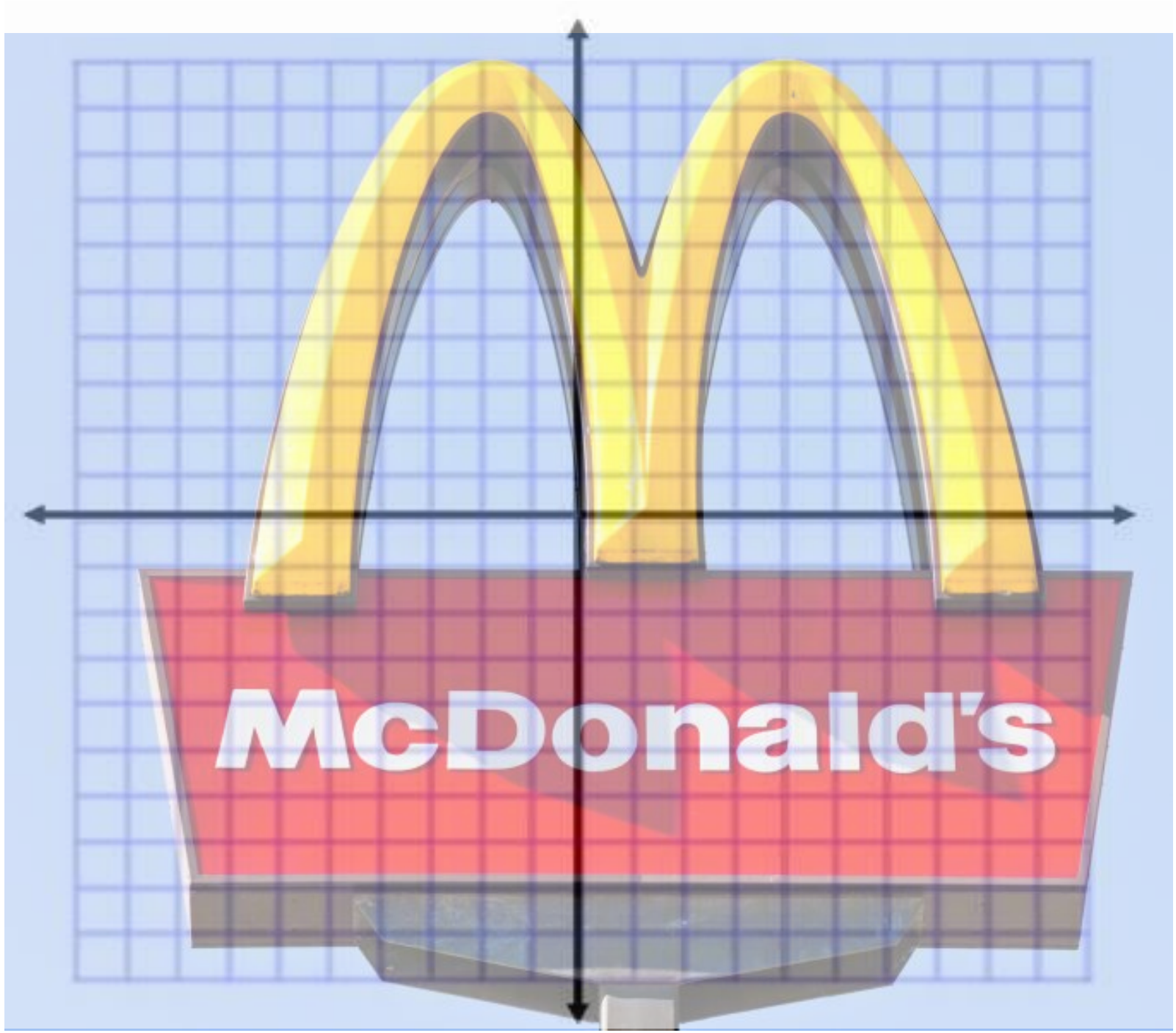











McDonald's

UNIVERSITY OF MAINE AT FARMINGTON
COLLEGE OF EDUCATION, HEALTH AND REHABILITATION

LESSON PLAN FORMAT
EDU 361 Secondary/Middle Math Methods

Teacher's Name: Mr. Cabaniss **Lesson #:** 3
Grade Level: 10 **Numbers of Days:** 2

Topic: Relating parabolas and circles to the real world and effectively completing the square to help solve real world issues.
Room Arrangement: The room will be set up in a parabola. A) because it helps with engagement and room cooperation and B) because it would fit right into the lesson with parabolas.

PART I

Objectives:

Students will understand that:

- conic sections provide the basis for a variety of shapes and equations that are used all around them and will appear more in Algebra II.

Students will know:

- how to relate conic sections such as parabolas and circles--and completing the square for each--to the real world.

Students will be able to do:

- illustrate parabolas and circles from equations and real world examples

Product: Poster graphing project--Students will create a poster that incorporates the four conic sections and how they are similar and different. Each of these will have a real world example.

Common Core State Standards (CCSS) Alignment

Content Area: Geometry

Grade Level: High School

Domain: Expressing Geometric Properties with Equations

Cluster: Translate between the geometric description and the equation for a conic section

Standard(s):

- Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.
- Derive the equation of a parabola given a focus and directrix.
- In addition… Introduce ellipses and hyperbolas

Which CCSS Mathematical Practice(s) will be addressed (list the number and the description):

1. Make sense of problems and persevere in solving them.
4. Model with mathematics

Rationale: (for both the CCSS standards and the practice(s))
Through examining all kinds of real world examples of parabolas and circles as they relate to completing the square, students will get a much better understanding for why this is type of mathematics is used. They will be given the opportunity to consider how this could relate to a hobby of theirs and demonstrate their knowledge of what they've learned through something they enjoy. Through the use of modeling and persevering through problems that are not simply taken out of the book, students will have a much better sense of problem solving and be able to think critically about these concepts.

Assessments

Formative (Assessment for Learning)
Section I – checking for understanding during instruction

Write what you know--students will be asked to write as much as they know about the topic we are covering. I will ask them to see if they can relate any of it to the real world to deepen their understanding.

Section II – timely feedback for product (self, peer, teacher) Create the checklist
Students will use a checklist to make sure they have all the essential elements for their summative assessments before their posters are completed. It will be important for them to be aware of what they need to produce before they do too much.

After they reflect on their own, they will get in groups of two and share their drafts with their partners. Partners will write down constructive criticism to help improve their summative

assessments.

Following this, when students have started their summative assessments, I will be able to check with them individually to make sure they are on the right track. The posters will be done in and out of class, although, I will be able to frequently check with them to make sure progress is going well.

Summative (Assessment of Learning): (Description of Product)

Poster graphing project--Students will create a poster that incorporates the four conic sections and how they are similar and different. Each of these will have a real world example.

Integration

Technology and SAMR Level

Desmos--Technology at the augmentation level that allows for the intuitive creation of graphs and even has the capability of animation. This tool will be used during instruction and the students will be able to utilize it themselves to further their understanding. They will be able to check that the equation they started with is the same as the one they ended with after completing the square by graphing both and seeing if they are the same graph.

Other Content Areas:

English--by creating the poster students will need to graph as well as write descriptions of what they are doing. In addition, by presenting their posters they will hit on the public speaking component of English.

Science--because of their autonomy to create what they want for their poster, they could be able relate their parabolas and circles to a science related topic if that is something they are interested in.

Instructional Model

Through this lesson I will use Concept Formation which will eventually lead into Unguided Inquiry for lesson 4.

Rationale:

In this lesson students will have individual and group time through the use of concept formation to deepen their understanding of the real world applications of parabolas and circles. Through intrapersonal thinking time, they will have the opportunity to think independently which will help their individual problem solving. Following independent work time they will group together

to collaborate on other ideas related to circles and parabolas--eventually concluding with extended learning outside of the classroom.

Groupings

Section I - Graphic Organizer & Cooperative Learning used during instruction

Students will use a step by step chart to logically keep track of their thoughts as they consider different ways parabolas and circles can be related to the real world.

For the cooperative learning model students will use think, pair, share. This will fit very nicely into the concept formation learning model where students will think individually and then work together to help push each other's thinking deeper. It will not explicitly be said that this cooperative learning model is used because it is used throughout the lesson.

Section II – Groups and Roles for Product

Students will be responsible for equally distributing responsibilities for the poster project. They will be in groups of two so there should be plenty for each student to do. They will end up doing a short feedback questionnaire for me to get a good idea of how much effort was put in by each student.

Differentiated Instruction

Motivational Strategy (Tell which Posamentier and Krulik motivational strategy will be used and credit them. Describe how you are using it and why.) ***NOTE: Use a variety across the unit.***

Through throwing object in the room I hope to catch students' attention through a "Gee-whiz" amazing mathematical result. We will throw things (safely of course) and consider what the graphs of the projectiles will look like.

Motivational strategies were taken from "The Art of Motivating Students--For Mathematics Instruction" written by Alfred S, Posamentier and Stephen Krulik.

Multiple Intelligences Strategies ***Note: Address at least six. Delete any you do not address.***

Logical: By considering real world applications students will need to logically problem solve to arrive at their desired answer.

Verbal: Because students will get into groups to share their findings for parabolas and circles, they will be able to verbalize their findings and hear others finding verbally.

Visual: Through the use of Desmos graphing and my pictures on the board students will have plenty of opportunities to find visuals for what they are considering.

Musical: During their poster project students will be able to come up with ANY real world application of circles and parabolas they can think of… i.e. a banjo would be a great

representation of a musical instrument that contains a circle.
Intrapersonal: By having time to think and brainstorm individually, students will have plenty of intrapersonal time.
Interpersonal: The cooperative learning model think, pair, share will allow students to work together and work interpersonally.
Kinesthetic: The hook will allow students to get out of their seats and throw/catch (safely) projectile objects.

Modifications/Accommodations
From IEP's (Individual Education Plan), 504's, ELLIDEP (English Language Learning Instructional Delivery Education Plan) *I will review student's IEP, 504 or ELLIDEP and make appropriate modifications and accommodations.*

Plan for students who are missing pre-requisite skill(s):
Although tiering can work, I do not want some students drastically ahead of others. Therefore missing pre-requisite skills will be taught as they become relevant in the class. Students who I feel grasp concepts well will be strategically placed in the room near Evangeline, Rabiu, and Mutumbo, who are lacking pre-requisite skills. These three students, and others who are struggling, will be encouraged to advocate for themselves so they can get the most out of their learning. They will do this by either asking me or a peer who may be able to help them.

Plan for accommodating Special Education:
Both Mutumbo and Rob are receiving special education services and have an IEP that outlines modifications and accommodations that are specific to their learning. They are almost entirely immersed in my classroom, but will have a resource room with additional attention if they need it. However, I will provide as much support as I need to, and their peers will be able to assume leadership roles to assist them as well.

Plan for accommodating English Language Learners:
Each lesson will be made so that there are plenty of visuals and Rusney, Gisele, and Krystopher will be able to work hands on to get a grasp on the concepts. Conversation about parabolas and circles will happen, although there will be numerous opportunities to construct and build which leaves time for one on one attention if needed.

Plan for accommodating absent students:
Through the use of my Weebly webpage, I will be able to update it and keep a detailed agenda of what was covered in class. Students will still be responsible for coming to see me to get the required papers they missed. In addition, students will have their success teams that they can always fall back on to check with to make sure they have all the necessary information.

Extensions (tiering, gifted students, the students who already know it, etc…)
Sam, Damien, Grace, and Gisele are all student who perform above and beyond in the math classroom. These students will have the opportunity to push themselves to the next level with the construction of other geometric shapes graphically. They may be asked, after an individual meeting with the student, to do some independent research to further their understanding of specific topics. These students may also be used as an aid to me to assist students who are struggling with the material.

Materials, Resources and Technology

For this lesson I will need several stress balls (they need to be soft so they don't injure anyone)
Poster
Markers
Rulers

Source for Lesson Plan and Research

Examples of real world parabolas with completing the square:
https://www.mathsisfun.com/algebra/quadratic-equation-real-world.html

Video students should watch to get them acquainted with ellipses:
https://www.khanacademy.org/math/algebra2/conics_precalc/ellipses-precalc/v/conic-sections-intro-to-ellipses

Video students should watch that get them acquainted with hyperbolas:
https://www.khanacademy.org/math/algebra2/conics_precalc/hyperbolas-precalc/v/conic-sections-intro-to-hyperbolas

Think, Pair, Share cooperative learning activity… Among others:
https://www1.umn.edu/ohr/prod/groups/ohr/@pub/@ohr/documents/asset/ohr_89185.pdf

PART II: *Note: The purpose of Part II is to take everything from Part I and make it come alive with details in such a way that you can easily teach from it but also a substitute unfamiliar with your content area could carry out the lesson.*

Day 1:

Cool random math (5 min)
Previous class check-in (5 min)
Hook with videoing the path of projectile objects and looking at the position vs. time (10 min)
Examples with real world parabolas (20 min)
Independent work with considering more examples and working the equations out using their previous understanding of parabolas (15 minutes)
Group work with collaboration to spark new ideas (10 min)
Introduction to poster project (10 min)
Plan parabola component of poster project (10 min)

Day 2:
Cool random math (5 min)
Previous class check-in (5 min)
Examples with real world circles (15 min)
Independent work considering more examples and drawing on their previous knowledge of circles (15 min)
Group work with collaboration to spark new ideas (10 min)
Work on/finish poster project (30 min)

Teaching and Learning Sequence (2-3 pages)

Day 1:
(5 min) To open class, we will start with the cool random math for the day. This is more along the lines of optical illusions, although there is still math involved and it is very interesting.

(5 min) Then the students will complete their previous class check in to see what kind of knowledge they have retained.

Open
Introduce the topic and ask a question that will generate a list of terms:
(10 min) We will first start with the hook that will get students excited about learning more about parabolas and the real world application of them. Similar to Dan Meyer's concept of having students as the questions they want to solve, we will use a projectile of sorts (could be thrown) and students will write down some questions they have about it which might include what it's maximum height is, how far it travels, how long it is in the air at its maximum height, etc… and we will use the concept of parabolas to do this.

Body
List:

(20 min) Students will then list all different types of real world parabolas they can think of and how they could be graphed (ex. position vs. time, height vs. time, etc…). They should try to graph each informally so they can get an idea of what their picture might look like. More than likely their parabolas will either be opening up or down, so they should pay close attention to that as well as how steeply it opens up or down.

Group:
(15 min) Having done individual research, now students will get in groups of three to share ideas and group their thoughts by how the parabolas open and behave.

Label:
(10 min) Having just grouped different parabolas, students will now label what they have by their classification (opens upwards, downwards, left, right, steep, shallow, etc…). Once they have completed this step they will start to construct the actual equation for each of the parabolas. Example 1 is what I will model for the students so that they have a good idea of what they should be doing.

Close
Call students' attention to the concepts or generalizations that arise from their groupings.
Prompt:
(20 min) Students will get together in their groups for their poster project and come up with a plan for how they would like to divvy up roles and what their plan of attack is for the project. Their poster project will be hung up around the room following its completion so others will be able to see what they have created.

Extend learning through an additional assignment:
The students' math mission is to meet with their partner and work on the parabola stage of their poster project because the circle portion follows.

Day 2:

(5 min) Cool random math to start the class. Just recently mathematicians have finally discovered, what they think is, the 15th and final type of pentagon that can be tiled.

Open
Introduce the topic and ask a question that will generate a list of terms:
(5 min) Now students will be given a previous class check in to see what information they have retained. It will not only cover content from the previous class, but also material that has been covered up to this point so they start to recall on their previously learned skills. Each student will

be instructed to find a type of problem from a specific topic we covered. They will modify the problem so it is slightly different than the first time and give it to their peer to complete.

(10 min) Now students will have time individually to consider some different applications of circles in the real world and why they are necessary to think about. They will develop their own list and later get together to collaborate and share ideas.

Body

List:

(5 min) After the students come up with their list of real world circles and where they are relevant, they will identify them and name them depending on such things as size, functionality, etc… This will still be done individually so students have plenty of intrapersonal time.

Group:

(10 min) Still alone, students will then group the different circles that they have using only their own original groupings. This will come in handy when students end up getting together to collaborate their findings. As students do this, they should consider what the graphs of each of these circles look like and other important components such as the area, circumference, diameter, and radius. I would like them to graph one of the ideas they came up with and find the equation for the circle. Example 2 models what I am expecting from the students.

Label:

(10 min) Now students will get into groups of three to discuss their findings and label what they have discovered. Ideally they will have a very large list that they will be able to draw from when they finish up their poster project.

Close

Call students' attention to the concepts or generalizations that arise from their groupings.

Prompt:

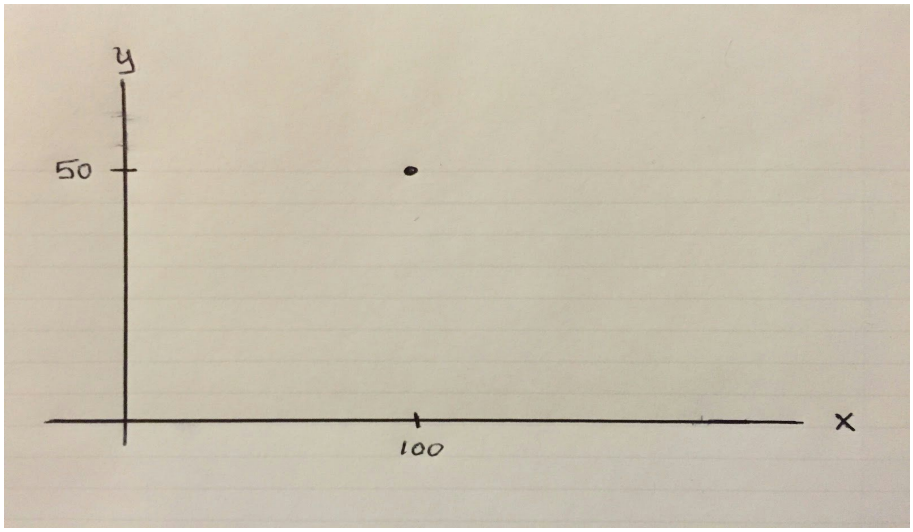
(30 min) Students will have the rest of class to work on their poster projects and finish them up. Once they are done they will be hung on the wall. During this time I will encourage peer to peer help; however, I will also be milling around the room to make sure students understand what they are doing before they get too in depth into their project.

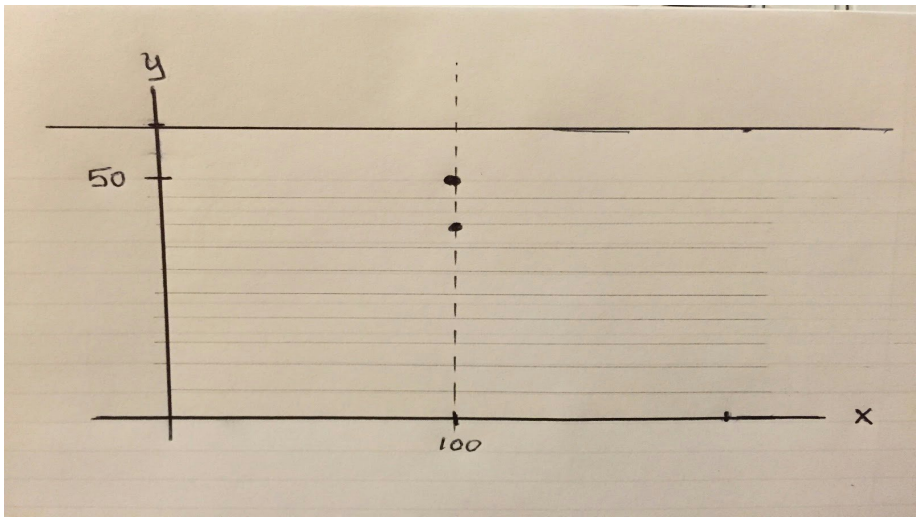
Extend learning through an additional assignment:

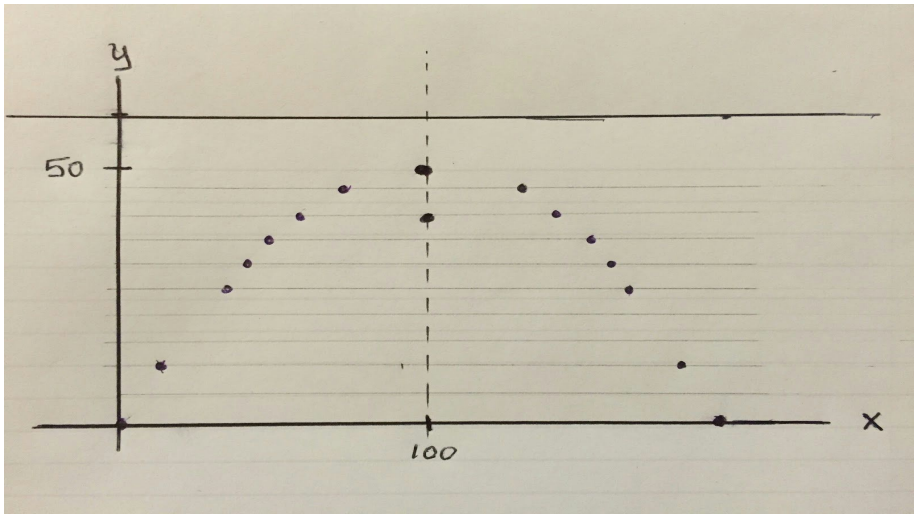
(5 min) Any students who do not finish their poster project during class will be expected to meet with their partner outside of class and complete it for the next class. In addition, students will be asked to watch these two videos on hyperbolas and ellipses for the next class so they can have a good head start into the unguided inquiry lesson.

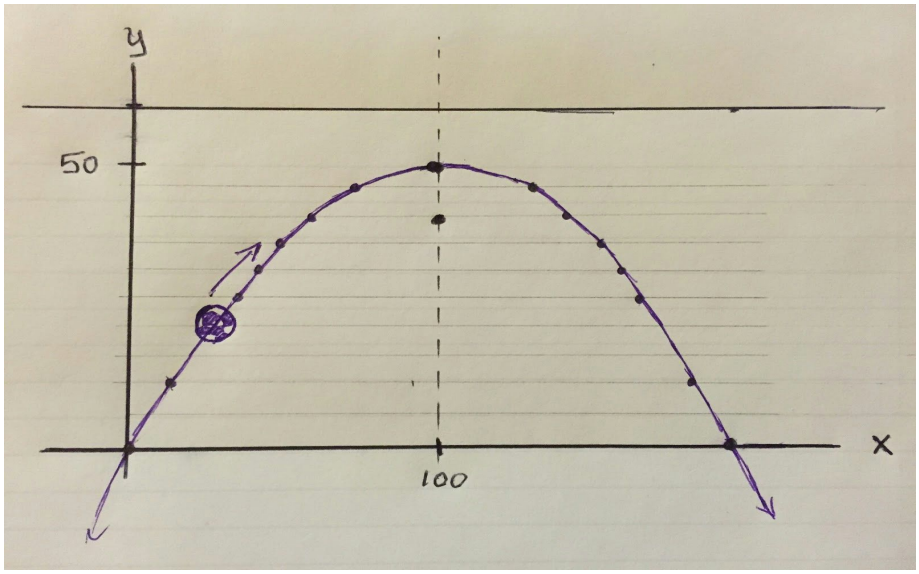
Content Notes (2-3 pages)

Example 1: You kick a soccer ball across a field. It's height vs. distance graph shows which picture? Where would the focus & directrix be? First students will pick where they want their vertex to be. Then they will determine where the focus and directrix will be after they do some measurements from the starting point that they are choosing. After that they will tap into the knowledge they have already learned to graph the rest of the parabola.

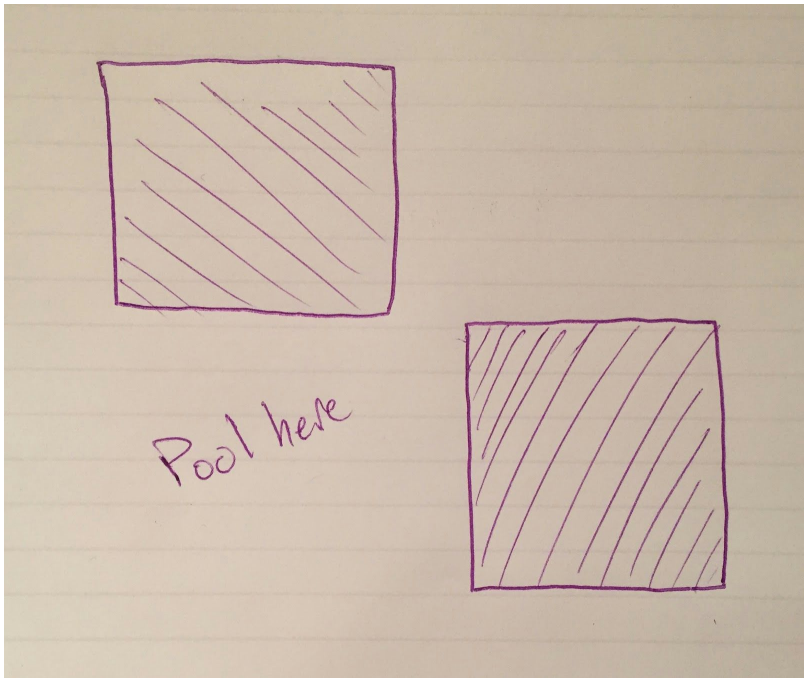








Example 2: You are constructing a pool between two adjacent buildings and want to find out what the center will be and how big the pool can be. We eventually get the equation $(x+11.25)^2+(y+12.5)^2=12.5^2$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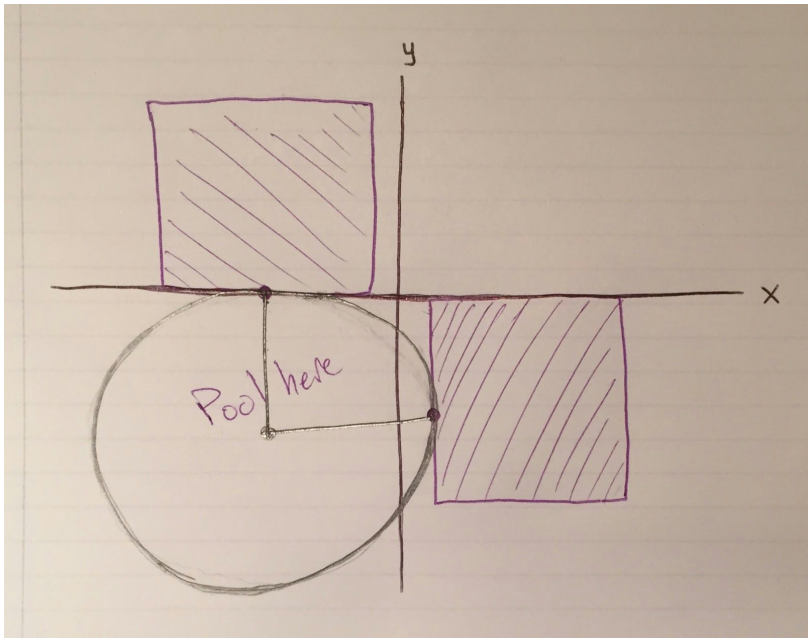
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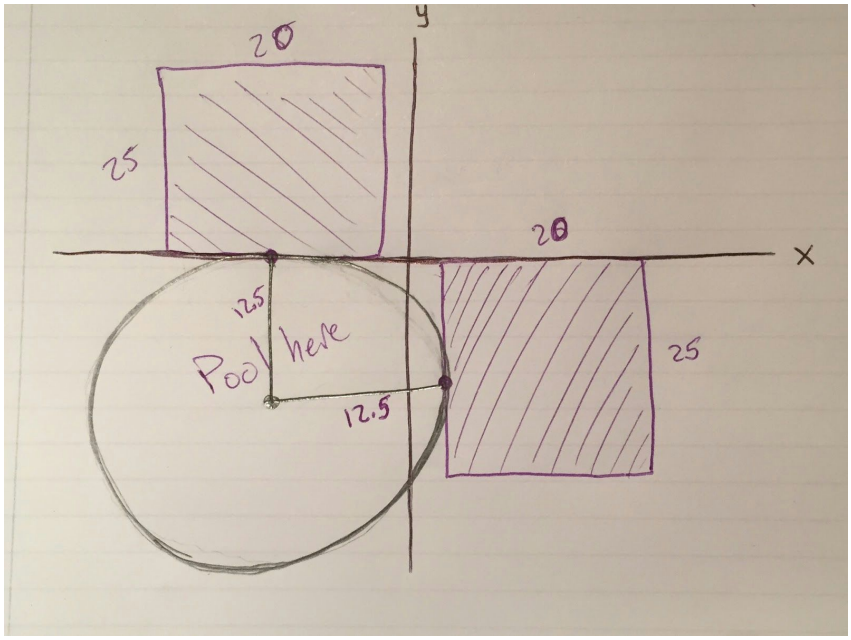
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Pool here
25
12.5

Poster Project Checklist

- ❑ Poster provides two examples of real world parabolic functions
- ❑ Poster provides two example of real world circle functions
- ❑ Poster gives a detailed explanation of how to solve for the answer of the parabolic problem
- ❑ Poster gives a detailed explanation of how to solve for the answer of the circular function.
- ❑ Poster shows clear picture of how the parabola was created using the focus and directrix
- ❑ Poster shows clear picture of how the circle was created using the Pythagorean theorem and radius
- ❑ Poster spaces work evenly and neatly
- ❑ Poster is aesthetically appealing and sufficient effort is evident

Poster Project Checklist

- ❑ Poster provides two examples of real world parabolic functions
- ❑ Poster provides two example of real world circle functions
- ❑ Poster gives a detailed explanation of how to solve for the answer of the parabolic problem
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- ❑ Poster spaces work evenly and neatly
- ❑ Poster is aesthetically appealing and sufficient effort is evident

UNIVERSITY OF MAINE AT FARMINGTON
COLLEGE OF EDUCATION, HEALTH AND REHABILITATION

LESSON PLAN FORMAT
EDU 361 Secondary/Middle Math Methods

Teacher's Name: Mr. Cabaniss **Lesson #:** 4
Grade Level: 10 **Numbers of Days:** 4

Topic: Using previous knowledge of parabolas and circles, use problem solving skills to develop a good understanding for ellipses and hyperbolas.
Room Arrangement: The room will be arranged in a way that will represent a hyperbola, such that the desks will make up the geometric shape.

PART I

Objectives:

Students will understand that:

- conic sections provide the basis for a variety of shapes and equations that are used all around them and will appear more in Algebra II

Students will know:

- the final two shapes created by conic sections (hyperbolas and ellipses)

Students will be able to do:

- derive the formulas for all the conic sections
- analyze hyperbolas and ellipses and how they relate to the real world

Product: iMovie--students will be in groups and be responsible for creating an iMovie that uses real world visuals to teach their peers about conic sections. They will be tasked with the challenge to act as news crew reporters and demonstrate their deep understanding of each conic section through a movie.

Common Core State Standards (CCSS) Alignment

(List Content Area, Grade Level, Domain(s), Standard(s), and Cluster(s))

Content Area: Geometry

Grade Level: High School

Domain: Expressing Geometric Properties with Equations

Cluster: Translate between the geometric description and the equation for a conic section

Standard(s):

- Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.
- Derive the equation of a parabola given a focus and directrix.
- In addition… Introduce ellipses and hyperbolas

Which CCSS Mathematical Practice(s) will be addressed (list the number and the description):

1. Make sense of problems and persevere in solving them.
4. Model with mathematics.
8. Look for and express regularity in repeated reasoning.

Rationale: (for both the CCSS standards and the practice(s))
In this lesson students will be exploring hyperbolas and ellipses on their own through unguided inquiry. They will be tasked with making sense of what they research and persevering to understand it themselves with help from me if needed. Through this process many patterns will arise in the form of formulas they they will be able to use to express their equations. In addition, they will be asked to provide examples of how what they are studying relates to the real world.

Assessments

Formative (Assessment for Learning)

Section I – checking for understanding during instruction

Graph Yo-self--students will be asked to work together to graph themselves on the cartesian coordinate plane on the floor. They will need to graph parabolas, hyperbolas, circles, and ellipses.

Section II – timely feedback for product (self, peer, teacher)

Students will use a checklist to make sure they have all the essential elements for their summative assessments before their iMovies are completed. It will be important for them to be aware of what they need to produce before they do too much.

After they reflect on their own, they will get in groups of two and share their ideas and progress with their partners. Partners will write down constructive criticism to help improve their

summative assessments.

Following this, when students have started their summative assessments, I will be able to check with them individually to make sure they are on the right track. The iMovies will be done in and out of class, although, I will be able to frequently check with them to make sure progress is going well.

Summative (Assessment of Learning): (Description of Product)

iMovie--students will be in groups and be responsible for creating an iMovie that uses real world visuals to teach their peers about conic sections. They will be tasked with the challenge to act as news crew reporters and demonstrate their deep understanding of each conic section through a movie.

Integration

Technology and SAMR Level

Students will use the app Desmos on their iPads to take with them while they do their reporting. They can take pictures with the iPads and put the picture directly into the graph to help represent the conic section they are making an example of. This takes the technology to the modification level because of the capability of inputting pictures directly from wherever the students are.

Other Content Areas:

English--Through public speaking on iMovie, students will be able to tap into the English concentration during their summative assessment for the lesson.

Instructional Model

Unguided Inquiry

Rationale:

The previous three lessons led up to students being able to do independent research and discover hyperbolas and ellipses for themselves. They have developed critical thinking and problem solving skills throughout the past three lessons that will help them with unguided inquiry.

Groupings

Section I - Graphic Organizer & Cooperative Learning used during instruction

Students will be able to use the graphic organizer, Ladder, to help them with conceptualizing hyperbolas and ellipses. During the lesson the cooperative learning model "Speed Dating". Here they will first research information on hyperbolas and ellipses. Next, half of the students will position themselves in the room and stay there while the other half meet with each person for one

minute. After one minute students will switch partners and move onto the next person to discuss their findings.

Section II – Groups and Roles for Product

Differentiated Instruction

Motivational Strategy (Tell which Posamentier and Krulik motivational strategy will be used and credit them. Describe how you are using it and why.) *NOTE: Use a variety across the unit.*

When each of the students come into the room I will hand them a number that corresponds with a number on the floor. They will go stand on that number and, once everyone is in their place, it will create a hyperbola. We will then have a good discussion about some of the characteristics about the hyperbola and and what makes it so unique. This will get them questioning and hopefully spark their interest so they want to learn more.

Motivational strategies were taken from "The Art of Motivating Students--For Mathematics Instruction" written by Alfred S, Posamentier and Stephen Krulik.

Multiple Intelligences Strategies *Note: Address at least six. Delete any you do not address.*

Logical: Because there is reason behind why all of these shapes are formed the way they are, the logical learner will have a better time grasping the concepts of how/why?

Verbal: By using the cooperative learning model "speed dating" students will be able to verbally explain what they learned and how it all works.

Visual: By using the checking for understanding, "Graph Yo-self", Students will be able to see how the functions are graphed on the floor with them being part of it.

Musical: In the summative assessment, iMovie, students will be able to add any type of music that would make their presentation appealing. In addition, there are hyperbolas and ellipses found in music that students could research.

Intrapersonal: Through the instructional model, Unguided Inquiry, students will have plenty of time alone to research the topic of hyperbolas and ellipses and discover for themselves.

Interpersonal: The cooperative learning model "speed dating" will allow students to work with each other to get a better understanding of the concepts they are trying to learn.

Kinesthetic: By graphing themselves on the floor, students will be engaged and want to try new formulas that will allow them to move around more.

Naturalist: For the summative, iMovie, students will have the opportunity to go into the environment to find examples of each of the conic sections and report about it.

Modifications/Accommodations

From IEP's (Individual Education Plan), 504's, ELLIDEP (English Language Learning

Instructional Delivery Education Plan) *I will review student's IEP, 504 or ELLIDEP and make appropriate modifications and accommodations.*

Plan for students who are missing pre-requisite skill(s):
Although tiering can work, I do not want some students drastically ahead of others. Therefore missing pre-requisite skills will be taught as they become relevant in the class. Students who I feel grasp concepts well will be strategically placed in the room near Evangeline, Rabiu, and Mutumbo, who are lacking pre-requisite skills. These three students, and others who are struggling, will be encouraged to advocate for themselves so they can get the most out of their learning. They will do this by either asking me or a peer who may be able to help them.

Plan for accommodating Special Education:
Both Mutumbo and Rob are receiving special education services and have an IEP that outlines modifications and accommodations that are specific to their learning. They are almost entirely immersed in my classroom, but will have a resource room with additional attention if they need it. However, I will provide as much support as I need to, and their peers will be able to assume leadership roles to assist them as well.

Plan for accommodating English Language Learners:
Each lesson will be made so that there are plenty of visuals and Rusney, Gisele, and Krystopher will be able to work hands on to get a grasp on the concepts. Conversation about parabolas and circles will happen, although there will be numerous opportunities to construct and build which leaves time for one on one attention if needed.

Plan for accommodating absent students:
Through the use of my Weebly webpage, I will be able to update it and keep a detailed agenda of what was covered in class. Students will still be responsible for coming to see me to get the required papers they missed. In addition, students will have their success teams that they can always fall back on to check with to make sure they have all the necessary information.

Extensions (tiering, gifted students, the students who already know it, etc…)
Sam, Damien, Grace, and Gisele are all student who perform above and beyond in the math classroom. These students will have the opportunity to push themselves to the next level with the construction of other geometric shapes graphically. They may be asked, after an individual meeting with the student, to do some independent research to further their understanding of specific topics. These students may also be used as an aid to me to assist students who are struggling with the material.

Materials, Resources and Technology

List all the items you need for the lesson, including handouts.

Paper to give to students with numbers 1 thru however many students are in the class
tape
paper for floor
iPads

Source for Lesson Plan and Research

Introduction to hyperbolas:
http://www.purplemath.com/modules/hyperbola.htm

Introduction to hyperbolas (video):
https://www.khanacademy.org/math/algebra2/conics_precalc/hyperbolas-precalc/v/conic-sections-intro-to-hyperbolas

Introduction to hyperbolas:
http://www.mathsisfun.com/geometry/hyperbola.html

Introduction to ellipse:
http://www.purplemath.com/modules/ellipse.htm

Introduction to ellipse:
https://www.mathsisfun.com/geometry/ellipse.html

Introduction to ellipse (video):
https://www.khanacademy.org/math/algebra2/conics_precalc/ellipses-precalc/v/conic-sections-intro-to-ellipses

PART II: *Note: The purpose of Part II is to take everything from Part I and make it come alive with details in such a way that you can easily teach from it but also a substitute unfamiliar with your content area could carry out the lesson.*

Agenda:
Day 1
Cool random math (5 min)

Hook for hyperbolas (10 min)
Individual/pair think (5 min)
Preparation (5 min)
Plan of attack (5 min)
Work time (30 min)
iMovie intro (15 min)
Close (5 min)

Day 2:
Cool random math (5 min)
Hook for ellipses (10 min)
Individual/pair think (5 min)
Preparation (5 min)
Plan of attack (5 min)
Work time (20 min)
Speed dating (10 min)
iMovie work time (15 min)
Close (5 min)

Day 3:
Performance task (70 min)
Gallery walk and conversation (10 min)

Day 4:
Unit Exam (80 min)

Teaching and Learning Sequence (2-3 pages)

Day 1:
(5 min) To open class, we will start with the cool random math for the day. This is to get their minds firing up and hopefully engage them in something they might want to get more interested in. EXAMPLE 1.

Open
(10 min) Present stimulus material that suggests a problem or issue for study:
When each of the students come into the room I will hand them a number that corresponds with a number on the floor. They will go stand on that number and, once everyone is in their place, it will create a hyperbola. We will then have a good discussion about some of the characteristics about the hyperbola and and what makes it so unique. This will get them questioning and

hopefully spark their interest so they want to learn more.

(5 min) Guide students to state the problem in clear terms
Students will now have three minutes to think individually about the shape of the hyperbola and what it looks like. They should consider the shape, and how it may be similar/different from a parabola. This is simply creating hypotheses. After three minutes they will meet with a partner and discuss what they have found. They will write down as many questions as they can think of that they will later look back at during their research and answer.

Decide on appropriate methods to address the problem
(5 min) Following this, students will create a plan of attack for answering their questions with possible resources they may be able to use. I have a bank of resources already set aside for students to access; however, they should consider all of the different places they could find help (book, websites, me, peers, etc…)

(5 min) Set the guidelines for study
Students will have thirty minutes to research as much as they can and ask me as many questions as they can. There will not be any direct instruction during this time unless students ask for help. They should be able to answer most if not all of their questions in class that they wrote down at the beginning.

Body
(30 min) Monitor students as they employ their methods. Prompts to encourage careful study: Students will not use the list of websites I have created in addition to any that they find useful on their own. I will use proximity control to monitor the room and make sure students are on task and working on the presented assignment. This will be a great time to provide individual instruction to any students who are struggling with any of the material--new and old--that we have covered thus far. It will also be a great time for leaders in the classroom to assist other students who may not pick up new material as quickly.

For this class we will be examining hyperbolas and how they are similar and different to parabolas. Gifted students will be challenged to show how completing the square is similar and different with hyperbolas and parabolas. They should be able to draw some conclusions that allow them even further their understanding of manipulating equations algebraically that will help them for Pre-Calculus.

(15 min) After they have completed this work they will have the opportunity to work with their partner on their iMovie to create a plan for that. They should have a good idea going into the next class so they can finish it for homework later on. During this time I will hand out their

checklist so they know what is expected of them.

Close

(5 min) Encourage students to draw conclusions regarding (a) the problem and (b) the process of investigation

Now to close class we will have a discussion about what all of the students found, what surprised them, and what was logical and understood. We will also discuss how the researched what they found what helped them. This type of conversation will help them for the next class when they do the same types of research on ellipses.

Day 2:

(5 min) To open class, we will start with the cool random math for the day. EXAMPLE 2.

Open

Present stimulus material that suggests a problem or issue for study:

When each of the students come into the room I will hand them a number that corresponds with a number on the floor. They will go stand on that number and, once everyone is in their place, it will create an ellipse. We will then have a good discussion about some of the characteristics about the ellispe and and what makes it so unique. This will get them questioning and hopefully spark their interest so they want to learn more.

Guide students to state the problem in clear terms

Students will now have three minutes to think individually about the shape of the ellipse and what it looks like. They should consider the shape, and how it may be similar/different from a circle. This is simply creating hypotheses. After three minutes they will meet with a partner and discuss what they have found. They will write down as many questions as they can think of that they will later look back at during their research and answer.

Decide on appropriate methods to address the problem

(5 min) Following this, students will create a plan of attack for answering their questions with possible resources they may be able to use. I have a bank of resources already set aside for students to access; however, they should consider all of the different places they could find help (book, websites, me, peers, etc…)

Set the guidelines for study

Students will have thirty minutes to research as much as they can and ask me as many questions as they can. There will not be any direct instruction during this time unless students ask for help.

They should be able to answer most if not all of their questions in class that they wrote down at the beginning.

Body

(20 min)Monitor students as they employ their methods. Prompts to encourage careful study: Students will not use the list of websites I have created in addition to any that they find useful on their own. I will use proximity control to monitor the room and make sure students are on task and working on the presented assignment. This will be a great time to provide individual instruction to any students who are struggling with any of the material--new and old--that we have covered thus far. It will also be a great time for leaders in the classroom to assist other students who may not pick up new material as quickly.

For this class we will be examining ellipses and how they are similar and different to circles. Gifted students will be challenged to show how completing the square is similar and different with ellipses and circles. They should be able to draw some conclusions that allow them even further their understanding of manipulating equations algebraically that will help them for Pre-Calculus.

(10 min) Because ellipses are not as challenging as hyperbolas, students should not need to spend as much time as they did with hyperbolas. We will now use the cooperative learning model "Speed Dating" so students can go around and spend a couple minutes having good and meaningful conversations with their peers about what they have discovered. Once they have exhausted their time, they will move on to another partner quickly and fluidly and have some fun with the activity.

(15 min) After they have completed this work they will have the opportunity to work with their partner on their iMovie to further what they have already. They should have worked on if for their math mission. During this time they should know when it will be finished and how long it will take them.

Close

Encourage students to draw conclusions regarding (a) the problem and (b) the process of investigation

Now to close class we will have a discussion about what all of the students found, what surprised them, and what was logical and understood. We will also discuss how the researched what they found what helped them. This type of conversation will be good because I will start to get them thinking about the performance task they will need to work on next class to wrap up their understanding of all of the concepts. In addition, they will need to start preparing for the exam.

Day 3:

On this day students will have the entire class to work on their performance tasks. This will be a great project based way for them to demonstrate their knowledge, learn as they go, and have fun doing it. The performance task is as follows:

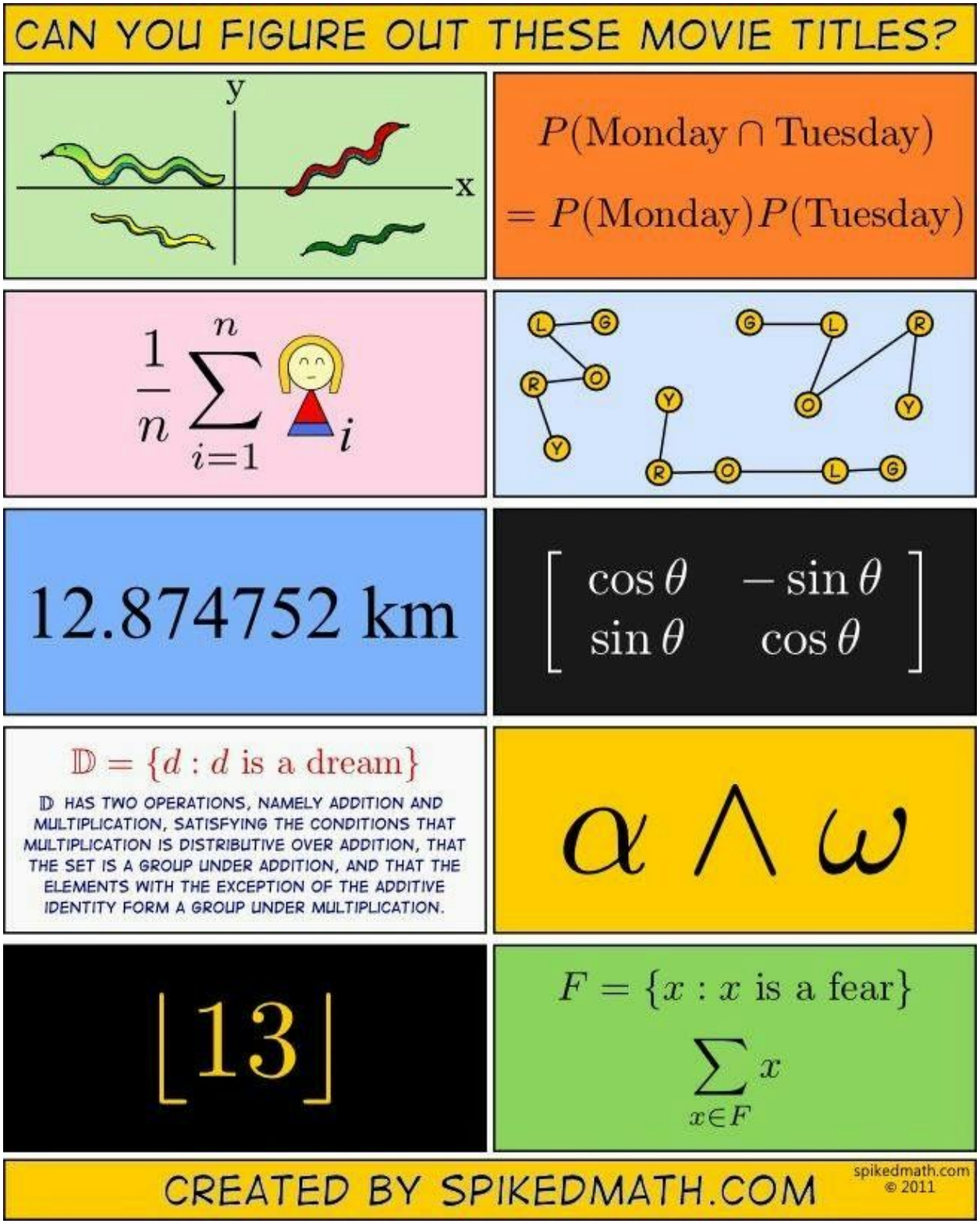
You just got a job as an artist for the Virtual Math Museum. The founder, Jorgan Von Strangle, has asked you to construct a piece that will go on display at the newest open house they will be having. Many of the top mathematicians from around the world will be in attendance, and they will decide whether they would like to sponsor the Virtual Math Museum. The piece Jorgan has asked you to create must be constructed with only parabolas, hyperbolas, ellipses, and circles. You must use Desmos Graphing Calculator to create your image that will be put on display. If the display you created impresses the mathematicians, they will sponsor the Virtual Math Museum and you will get a handsome raise.

Day 4

Unit exam

Content Notes (2-3 pages)

Example 1:


CAN YOU FIGURE OUT THESE MOVIE TITLES?
y
x
$P(\text{Monday} \cap \text{Tuesday}) = P(\text{Monday})P(\text{Tuesday})$
$\frac{1}{n}\sum_{i=1}^{n} i$
L G R O Y
G L R O Y
R O L G
12.874752 km
$\begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$
$\mathbb{D} = \{d : d \text{ is a dream}\}$
$\mathbb{D}$ HAS TWO OPERATIONS, NAMELY ADDITION AND MULTIPLICATION, SATISFYING THE CONDITIONS THAT MULTIPLICATION IS DISTRIBUTIVE OVER ADDITION, THAT THE SET IS A GROUP UNDER ADDITION, AND THAT THE ELEMENTS WITH THE EXCEPTION OF THE ADDITIVE IDENTITY FORM A GROUP UNDER MULTIPLICATION.
$\alpha \wedge \omega$
$\lfloor 13 \rfloor$
$F = \{x : x \text{ is a fear}\}$
$\sum_{x \in F} x$
CREATED BY SPIKEDMATH.COM
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Example 2:

Sayings as Mathematical Equations

1. Hell^{No}
2. $(.10) = 12x$
3. $\text{Enough} = \text{Enough}$
4. $\text{Fair} + x^2$
5. $\text{See } \sqrt{(-1)}\ 2(\sqrt{(-1)})$
6. $-1(\text{Nancy})$
7. $\pm$ You
8. $\text{Environment} \cdot x = \text{You}$
9. 42

Answers on thedoghousediaries.com/5975 DOGHOUSEDIARIES

iMovie Checklist

- ❑ iMovie provides at least one real world examples of each of the following:
  - ○ Parabola
  - ○ Circle
  - ○ Ellipse
  - ○ Hyperbola
- ❑ There is equal distribution of work done by each person involved
- ❑ Within the iMovie there is plenty of explanation given either verbally or visually about how ellipses and hyperbolas are derived and solved for
- ❑ The iMovie is well put together and flows smoothly

iMovie Checklist

- ❑ iMovie provides at least one real world examples of each of the following:
  - ○ Parabola
  - ○ Circle
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- ❑ Within the iMovie there is plenty of explanation given either verbally or visually about how ellipses and hyperbolas are derived and solved for
- ❑ The iMovie is well put together and flows smoothly

CELEBRATION OF KNOWLEDGE!

Name:_____ Date:_____

Show all of your work—work must be shown for credit to be given. If you need additional time it can be granted.

Complete the square for the following problems and determine what type of geometric object it is (4pts each):

1. $x^2 + 6x - 7 = 0$

This is a_____

2. $4x^2 + 4y^2 - 16x - 24y + 51 = 0$

This is a_____

3. $4x^2 + 9y^2 - 48x + 72y + 144 = 0$

This is a_____

4. $4x^2 + 40x - 5y^2 + 30y - 45 = 0$

This is a_____

For the following problems, state the radius and center of the circles (2 pts each):

5. $(x-2)^2+(y-3)^2=16$

Radius:

Center:

6. $x^2+(y+3)^2=25$

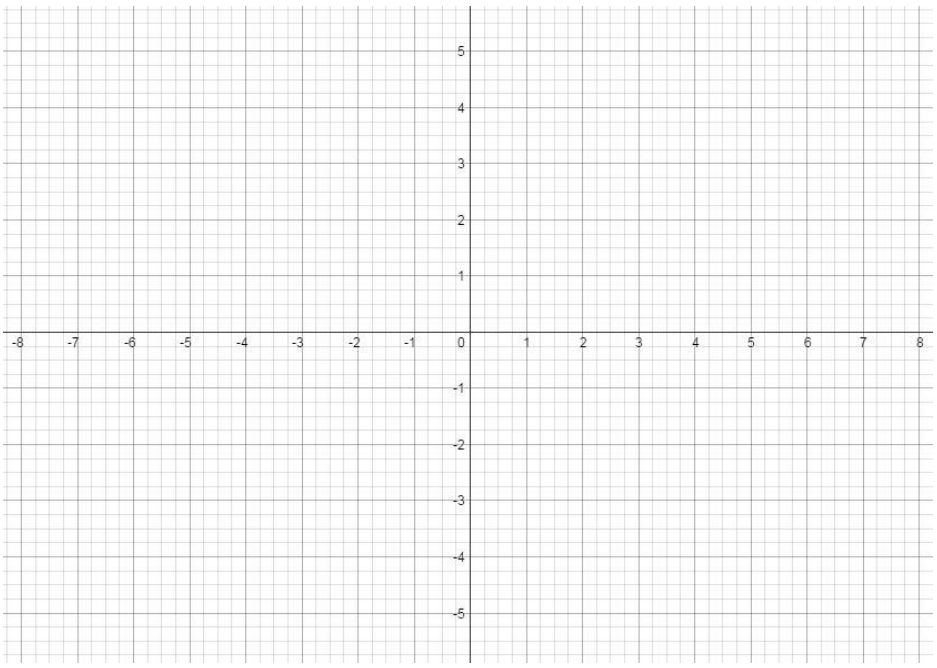
Radius:

Center:

Create an equation from the following information, then graph (3 pts):

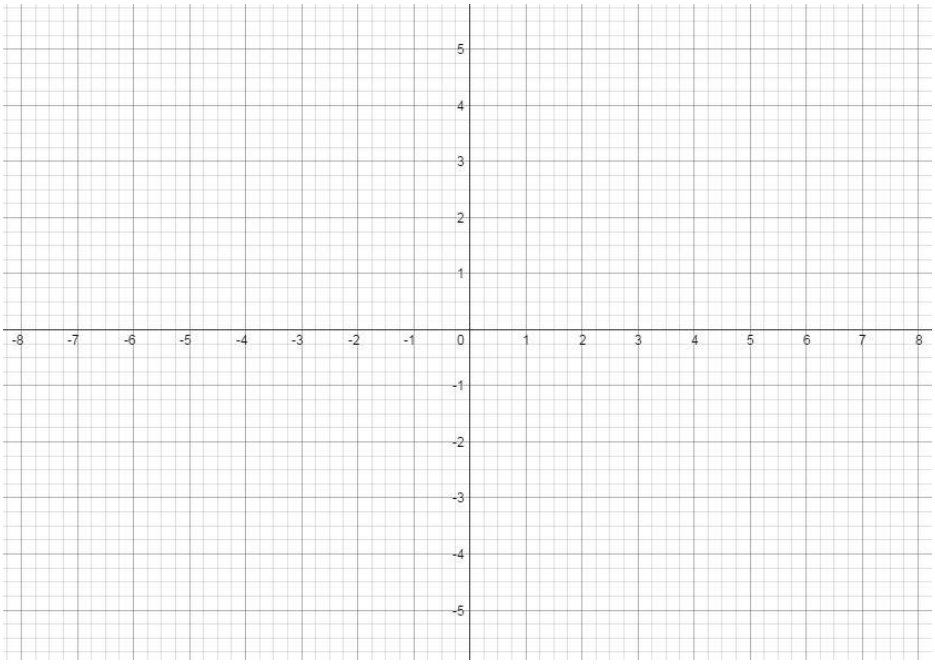
7. Parabola with vertex (5,–2) and directrix y = –5

Equation:_____



8. Parabola with vertex (3,1) and focus (3, —1)

Equation:_____

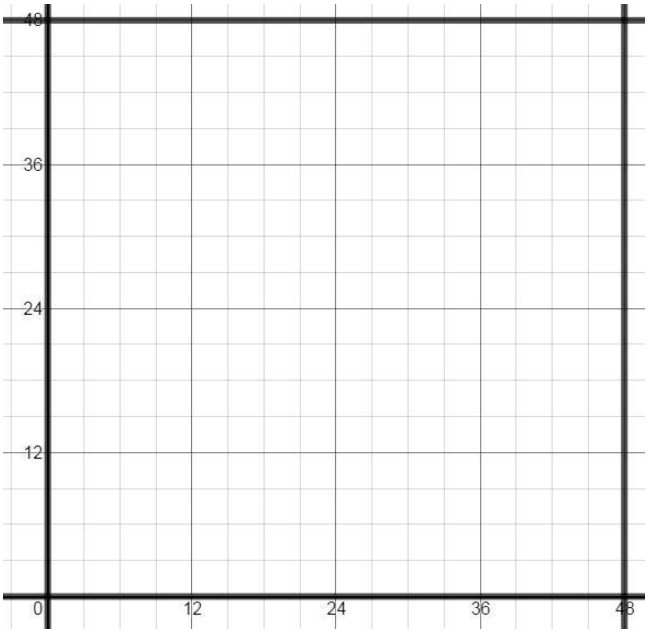


Using the Pythagorean Theorem, derive the equation for a circle:

9. Center at (2,3) with Radius = 4

10. Center at (-1, 5) with Radius = 3

A square brick pizza oven has an area of 2304 in^2 as shown below.



11. How many pizzas can fit in the oven at one time if each pizza has a radius of 6”?

12. Find the equation for the pizza that would fit in each corner of the brick oven.

Extra Credit: Simplify the following…

$$\left(\left(2\int_{e}^{\pi} 3x^2\,dx\right)\left(\frac{5-5}{1000}\right)\left(\sin\left(\frac{3\pi}{2}\right)-\sqrt[3]{3}\right)\right)$$

CELEBRATION OF KNOWLEDGE!

Name:_____ Date:_____

Show all of your work—work must be shown for credit to be given. If you need additional time it can be granted.

Complete the square for the following problems and determine what type of geometric object it is (4pts each):

1. $x^2 + 6x - 7 = 0$

This is a Parabola

$(x + 3)^2 = 16$

2. $4x^2 + 4y^2 - 16x - 24y + 51 = 0$

This is a Circle

$(x - 2)^2 + (y - 3)^2 = \frac{1}{4}$

3. $4x^2 + 9y^2 - 48x + 72y + 144 = 0$

This is a **Ellipse**

$\frac{(x-6)^2}{36} + \frac{(y+4)^2}{16} = 1$

4. $4x^2 + 40x - 5y^2 + 30y - 45 = 0$

This is a **Hyperbola**

$\frac{(x+5)^2}{25} - \frac{(y+3)^2}{20} = 1$

For the following problems, state the radius and center of the circles (2 pts each):

5. $(x-2)^2+(y-3)^2=16$

Radius: **4**

Center: **(2, 3)**

6. $x^2+(y+3)^2=25$

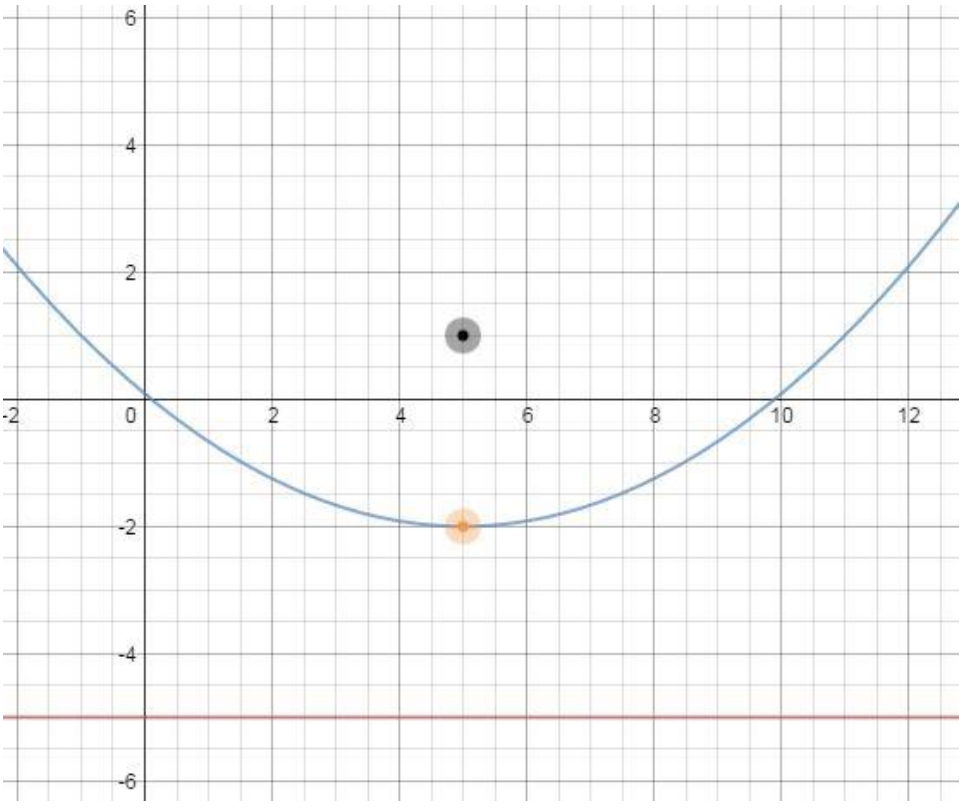
Radius: **5**

Center: **(0, —3)**

Create an equation from the following information, then graph (3 pts):

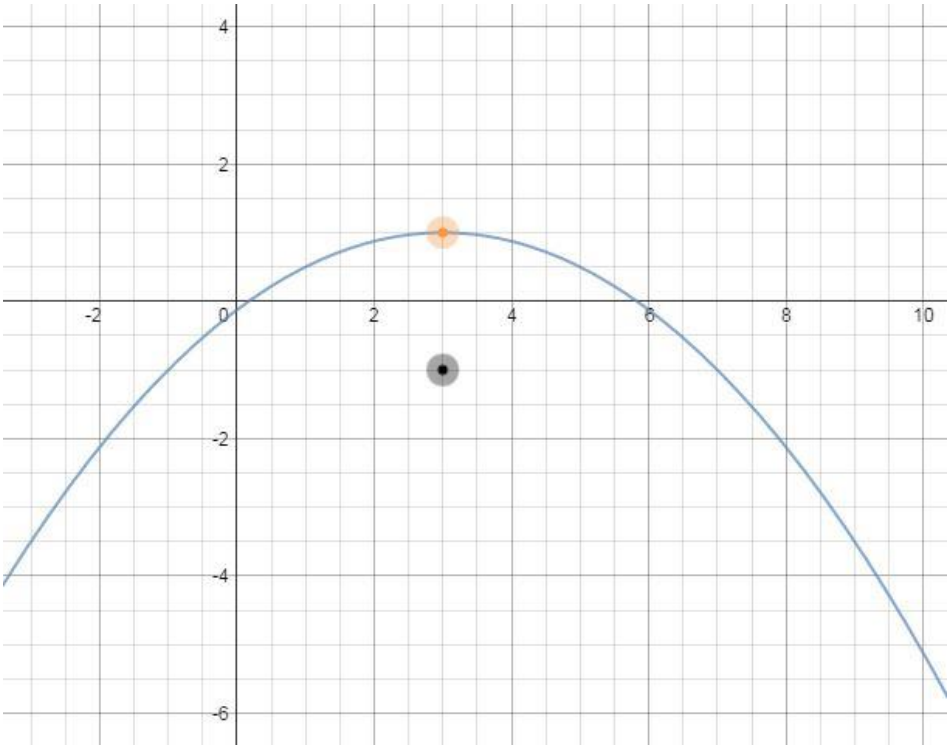
7. Parabola with vertex (5,–2) and directrix y = –5

Equation: $\boldsymbol{(x-5)^2=12(y+2)}$



8. Parabola with vertex (3,1) and focus (3, —1)

Equation: $(x-3)^2 = -8(y-1)$



Using the Pythagorean Theorem, derive the equation for a circle:

9. Center at (2,3) with Radius = 4

$(x-2)^2 + (y-3)^2 = 16$

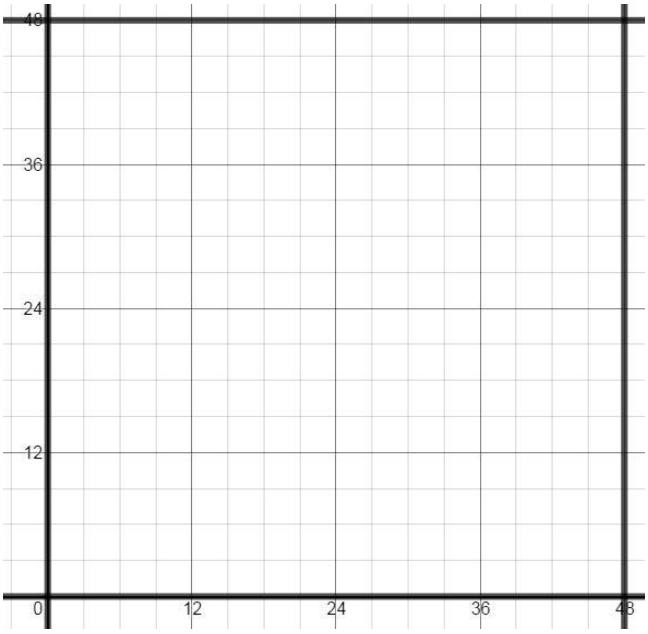
10. Center at (-1, 5) with Radius = 3

$$(x+1)^2+(y-5)^2=9$$

Extra Credit: Simplify the following…

$$\left(\left(2\int_e^{\pi}3x^2\,dx\right)\left(\frac{5-5}{1000}\right)\left(\sin\left(\frac{3\pi}{2}\right)-\sqrt[3]{3}\right)\right)=0$$

A square brick pizza oven has an area of 2304 in^2 as shown below.



11. How many pizzas can fit in the oven at one time if each pizza has a radius of 6”?

16 pizzas

12. Find the equation for the pizza that would fit in each corner of the brick oven.