

Workshop Description

In this workshop, students use art as a way to increase understanding of mathematical concepts. Students are first guided through activities that look at everyday objects and break them down into simple shapes. Then, students are introduced to a free online graphing program, Desmos, as a way to review graphing lines and circles. Finally, students use Desmos in an exploratory lesson aimed to increase relatedness around graphing circles and using inequalities. The exercise walks students through step-by-step equations to graph the face of a Bear, tying each equation back to a distinct part of the Bear, and it invites students to apply their own creative extensions, further solidifying their knowledge of circles and inequalities.

Workshop Requirements

- **Runs about 45-60 minutes** depending on class size and student engagement
- **Required or suggested materials**
 - Computer
 - Internet
 - Desmos (freely available)
- **Suggested ages/grades:** middle school → early high school
- **Prerequisite Knowledge:**
 - Familiarity with the equations for lines in point-slope form
 - Experience graphing points, and graphing lines in point-slope form

Learning Goals

- Learn to breakdown pictures into simple shapes
- Learn the graphing transformations of a line and circle (e.g., changing center and radius of a circle)
- Use inequalities in the context of lines and circles
- Learn how to use Desmos
- Make a cool drawing to remember the lesson & build relatedness
- Empower students to use their creativity in the context of art & math

Workshop Materials

- [Workshop Slides](#)
- [Desmos template](#) to review lines, circles, polygons, and relevant inequalities
 - [Tutorial](#) to accompany the above review template
- [Bear Graphing Desmos template](#)
 - [Tutorial](#) to accompany the above bear template

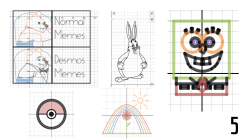
Suggested Notes and Tips for Running



- **Slide 1-2:** Intro Slides- introduce yourself and give a fun fact for the students



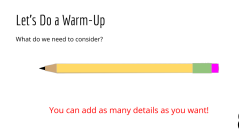
- **Slide 3-4:** Allow the students to get ready for the lesson. They will only need a laptop for the lesson but allow them to get ready for the class.



- **Slide 5:** Talk about how these pictures were created in Desmos and that they can also learn how to draw pictures with math and graphing



- **Slide 6-8:** These slides will cover the rules and how to graph pictures. You will be doing this one alone or with student input. You want to talk through your thinking process and how you are putting the shapes onto the pencil. This will help the students understand how to do this for the next example.



- **Slide 9:** Now it's the students' turn to break down a picture into simple shapes. Ask the students what shapes they see in Spongebob. You can overlay the shapes on it if you would like (using Insert >> Shape in the Slides menu). You will want them to go through this section fairly quickly since there's still a lot left in the lesson.

Now It's Your Turn!



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- **Slide 10:** Once you believe that the students have given you a sufficient amount of shapes you can show them this picture which breaks spongebob into simple shapes. (You could make this more detailed if you like.)

Let's draw a bear together!



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- **Slide 11:** Tell the students that this is what they could draw for the lesson's activity to get them excited.

Desmos

It's an amazing site that has a great graphing feature. You can draw anything you want as long as you have an equation for it!



Check out the template we've set up for you at the link below! We'll send it in the chat too.

<https://www.desmos.com/calculator/ignbqkzbb1>

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- **Slide 12:** Before we can get to making the pictures, we will want to learn how to use a graphing platform (Desmos) using an [interactive desmos page](#) to show the students how changing different coefficients will change the shape of a line and circle.

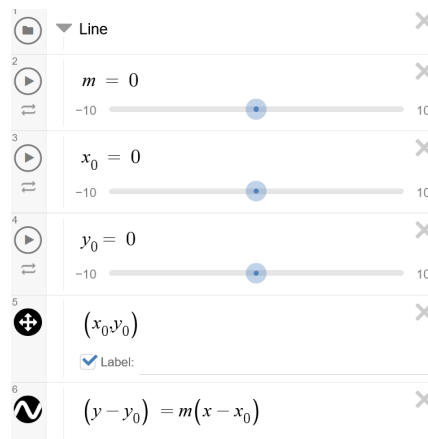
- Goals for this short activity:

- Understand impact of changing slope and point of a line
- Understand impact of changing variables for a circle
- Understand impact of inequalities for a line and circle
- Learn how to make polygons in desmos

- Tips for Desmos: If you are new to Desmos, play around with the triangle and circle buttons so that you can demo parts of the worksheet at a time. This is especially important for an interactive atmosphere if you want to ask students to predict what each equation will produce before it appears on the screen!
- Click the Triangle to open up the equations



- The menu of the equations will open up and you can play around with the sliders to change the graph



- To turn off the graph, press the button on the left that has a folder picture in it (currently in picture it is on)



- To turn on the graph, press the button on the left (currently in picture it is off)



- Give the students the links to the interactive desmos [template](#) and the follow-along Desmos [tutorial](#). The tutorial can be used if someone wants to review the material later, or if they get lost during the demo. The students will mostly be using the interactive Desmos page.
- Demonstrate what happens when you change the values of the coefficients for each of the different sections. Show them how changes in the equations translate to changes in the graph.
- Ask questions like, “What would happen if I make the slope 5?” “Where will a circle with this equation show up when I hit the button?”
- Don’t worry about the page getting messed up for later use. The link is already saved so you can change it how you like. If you or a student messes up the page, just reload the interactive desmos link and you should get the original desmos page.

Let's draw a bear together!



<https://www.desmos.com/calculator/sgjgdebuvt> 13

- **Slide 13:** Share the link to the [bear Desmos template](#) and to the [bear tutorial](#). Use the triangle and circle buttons to unveil parts of the bear bit by bit - you can ask the students what you think each line will do and what will be graphed. You can then turn on the equation’s graph to confirm or deny what the students thought.

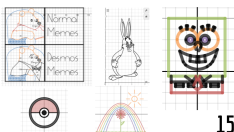
- We suggest engaging the class by asking them what will happen before you hit each circle button. This will also give you feedback on their understanding.

Now it's your turn!



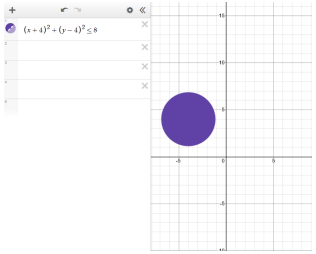


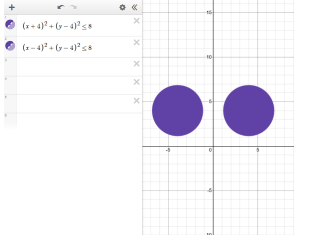
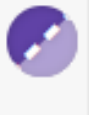

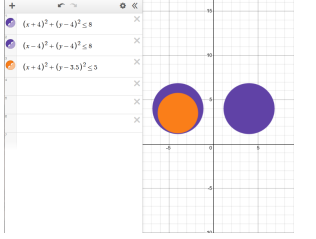


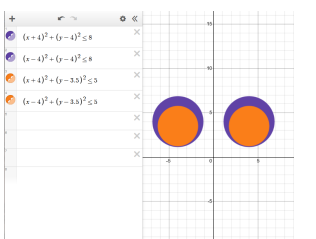


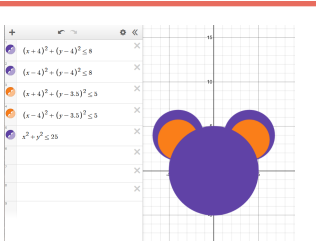
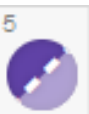

Add your piece to this slide deck when you're done so we can share! [tinyurl.com/2yha43cf](https://www.tinyurl.com/2yha43cf) 14

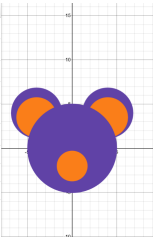














- **Slide 14:** Students will now be going off on their own to make some graphs. They can either make the bear, add new features to the bear, or make their own creation.
 - Give some ideas, such as adding a hat or body or trying a new animal.
 - Allow for about 25-30 ish minutes (either in class or as a fun homework assignment) and tell them to put their creations onto a shareable slide deck (you can make a copy of our sample share-out deck and then share the new URL with your students). After they finish graphing and posting it on the slides, you can have the students look at the gallery and have them present their graph if they would like. Otherwise, you can screenshare the slides and show the class what everyone has made.



- **Slide 15:** This will be the last slide and you should encourage the students to continue exploring graphs and how they relate to real world shapes.

Inputs and Outputs for Desmos Bear Activity

	<p>1  $(x + 4)^2 + (y - 4)^2 \leq 8$ </p>
	<p>2  $(x - 4)^2 + (y - 4)^2 \leq 8$ </p>
	<p>3  $(x + 4)^2 + (y - 3.5)^2 \leq 5$ </p>
	<p>4  $(x - 4)^2 + (y - 3.5)^2 \leq 5$ </p>
	<p>5  $x^2 + y^2 \leq 25$ </p>

	<p>6</p>  $3 \geq x^2 + (y + 2)^2$ 
	<p>7</p>  $(x - 2)^2 + y^2 \leq 0.3$ 
	<p>8</p>  $(x + 2)^2 + (y)^2 \leq 0.3$ 
	<p>9</p>  $x^2 + (y + 1.5)^2 \leq 0.2$ 
	<p>10</p>  $\text{polygon}((0, -1.5), (-1, -2.4))$ 

Enrichment Information

2020 Desmos Graphing Contest: <https://blog.desmos.com/articles/art-contest-launch/>

See if you can create a beautiful and mathematically advanced picture and win some money!

Please use these materials and tailor them to your students!

We encourage you to use these materials, editing and modifying them as appropriate for your students! When you use, share, incorporate, or modify these materials, please keep the license notice (from the footer) and credit "Olin College's course on Mathematics/Engineering Outreach for Adolescent Learners." We also humbly request that you email sarah.adams@olin.edu if you use these materials, as we are tracking their impact and how far they travel!