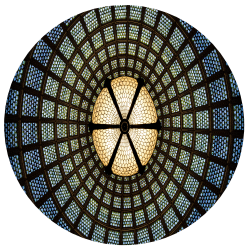

# Center of Attention

## Writing the Equation of a Circle

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| **Grade Level** | 9th – 10th Grade | **Time Frame** | 65 minutes |
| **Subject** | Mathematics | **Duration** | 1-2 class period(s) |
| **Course** | Geometry | | |

## Essential Question

How are triangles and circles related?

## Summary

In this geometry lesson, students will recall vocabulary about a circle, use their knowledge of midpoint and distance formulas to write the equation of a circle, and explore the connection between the equation of a circle and the Pythagorean Theorem. This is a multimodality lesson, which means it includes face-to-face, online, and hybrid versions of the lesson. The attachments also include a downloadable Common Cartridge file, which can be imported into a Learning Management System (LMS) such as Canvas or eKadence. The cartridge includes interactive student activities and teacher's notes.

## Snapshot

### Engage

Students recall what they know about circles.

### Explore

Given points on a circle, students use their knowledge of the distance formula to find the radius and/or diameter.

### Explain

Students complete guided notes with the class and/or watch a video to learn about the properties of a circle. These properties relate to the equation of a circle, how to write the equation of a circle given the endpoints of a diameter, and how to identify the center and radius from a given equation.

### Extend

Students write the equation of a circle from a graph and investigate the relationship between the Pythagorean Theorem and the equation of a circle.

### Evaluate

Students match equations with circles that have different characteristics.

## Standards

*Oklahoma Academic Standards Mathematics (Geometry)*

**G.C.1.2:** Use the distance and midpoint formula, where appropriate, to recognize and write the radius r, center (h,k), and standard form of the equation of a circle (x - h) 2+ (y - k) 2 = r 2 with and without graphs.

## Attachments

- Circle Characteristics—Center of Attention.docx
- Circle Characteristics—Center of Attention.pdf
- Common Cartridge—Center of Attention.zip
- Exit Ticket—Center of Attention.docx
- Exit Ticket—Center of Attention.pdf
- Guided Notes (Teacher Guide and Model Notes)—Center of Attention.docx
- Guided Notes (Teacher Guide and Model Notes)—Center of Attention.pdf
- Guided Notes—Center of Attention.docx
- Guided Notes—Center of Attention.pdf
- Lesson Slides—Center of Attention.pptx
- Writing Equations—Center of Attention.docx
- Writing Equations—Center of Attention.pdf

## Materials

- Common Cartridge (attached)
- Guided Notes handout (attached; one per student; printed front/back)
- Guided Notes (Teacher Guide and Model Notes) (attached; for teacher use)
- Writing Equations handout (attached; one per student; printed front only)
- Desmos account
- Pencils
- Coloring utensils (three per student)
- Student devices with internet access

10 minutes

# Engage

### Teacher's Note: Desmos Activity Preparation

To use this Desmos Classroom activity, select the following link: "Center of Attention: Synchronous." Create an account or sign in under the "Activity Sessions" heading. After you log in, the green "Assign" dropdown button will be active. Click the arrow next to the word "Assign," then select "Single Session Code." After making some setting selections, select "Create Invitation Code" and give the session code to students. For more information about previewing and assigning a Desmos Classroom activity, go to https://k20center.ou.edu/externalapps/using-activities/.

For more detailed information about Desmos features and how-to tips, go to https://k20center.ou.edu/externalapps/desmos-home-page/.

To set up the activity's pacing for students, select "View Dashboard" (next to the session code). In the upper-left corner of your screen, select the icon above the word "Pacing." Desmos Classroom should then prompt you to select the first and last screens that you want students to see. When prompted to set a range, select screens 1 and 5. Select "Restrict to Screens 1–5" to confirm your selection. This allows students to access only screens 1–5 at this time. For more information about teacher pacing, go to https://k20center.ou.edu/externalapps/pacing-activities/.

Provide students with your session code. Then, have students go to student.desmos.com and enter the session code.

### Teacher's Note: Sign-in Options

If students sign in with their Google or Desmos accounts, then their progress is saved, and they can resume the activity or view their work later. If students continue without signing in, they can complete the activity, but they must do so in one sitting. It is strongly recommended that students sign in; otherwise, they risk losing their work.

Introduce the lesson using **screens 1–2** of the Desmos activity. **Screen 1** displays the lesson's essential question. **Screen 2** identifies the lesson's learning objectives. Review each of these with students to the extent you feel necessary.

Give students time on **screen 3** to learn how to use the Desmos sketch tools.

On **screen 4**, have students use the Collective Brain Dump strategy to write what they know about circles. Ask students to use numbers and academic vocabulary to label the picture of the circle. Beside the picture, students should write anything else they know about circles that they did not label.

On **screen 5**, students are prompted to input their answers from the previous screen—specifically, the location of the circle's center and the lengths of the radius and diameter. As screen 5 has a built-in self-check function, students receive immediate feedback about their answers.

Then, ask students to pair up and compare their lists. Have students volunteer to share what they labeled, numerically and verbally. As students share out, write the circle characteristics on the board for the whole class to see.

**Teacher's Note: Guiding the Activity**

Students should be able to find the diameter and radius of the circle easily. Some students may write the relationship between the radius and diameter. Some students may find the circumference of the circle.

During this time, check for misunderstandings of prior knowledge. Encourage students to at least label the center, radius, and diameter—both with numbers and with words.

10 minutes

# Explore

On the Desmos dashboard, click the orange plus sign to allow students to progress to **screen 6**. Have students work with their partners to identify the center, radius, and diameter of a circle that has a center at (3, 5) and passes through (6, 9).

**Teacher's Note: Purpose**

The purpose of this activity is to activate students' prior knowledge of using the distance formula, which is applied here to find the radius of the circle.

As screen 6 has a built-in self-check function, students receive immediate feedback about their answers.

25 minutes

# Explain

### Teacher's Note: Preparation

Provide each student with three coloring utensils to complete this portion of the lesson.

Discuss students' strategies for finding the dimensions of a circle without its graph. Come to an agreement about using the distance formula to find the radius.

Then, pass out the attached **Guided Notes** handout to each student. Complete the handout as a class. Once finished, have students add it to their math notebooks if that is a classroom norm.

### Teacher Guide and Model Notes

Use the attached **Guided Notes (Teacher Guide and Model Notes)** document to help teach students what the equation of a circle is, how to write the equation of a circle given the endpoints of the diameter, and how to identify the center and radius of a circle from a given equation. The last two pages of the document provide an example of how a student ideally would fill out their copy of the Guided Notes.

### Optional Video

If taking notes is not a classroom norm and/or students need additional support, click the orange plus sign on the Desmos dashboard and consider having students select the link on **screen 7** to watch the "Center of Attention" video.

**Embedded video**
https://youtube.com/watch?v=nBpWyHBVr_M

In this video, students learn about the properties of a circle that relate to the equation of a circle, how to write the equation of a circle given the endpoints of a diameter, and how to identify the center and radius from a given equation.

15 minutes

# Extend

On the Desmos dashboard, click the orange "Edit" button and select screens 8 and 9. This allows students to access **screens 8–9**.

Pass out the attached **Writing Equations** handout to each student. Have students work with their partners to find the equation of each provided circle and type their final answers into the Desmos activity.

### Teacher's Note: Scaffolding

Using the handout and screens 8–9, students must find the equations of two different circles, given graphs of each. The graphs are of circles with the centers at lattice points, but the lattice points on each circle are not vertical or horizontal of the center.

This activity is scaffolded through having two diameters drawn in the first circle's graph, with each diameter connecting two lattice points. Students should follow the model of this first picture to imagine or draw their own diameter(s) on the second graph.

### Teacher's Note: Differentiation

Students are expected to write the equation of a circle by using the center and either the diameter or radius from each given graph. For an additional challenge, have students write the equations using two different approaches, one for each graph.

For example, students could use the endpoints of the diameter to find the equation of the circle on one of the two graphs.

As screens 8–9 have a built-in self-check function, students receive immediate feedback about their equations. Be sure to allow students time to find their mistakes, ask questions, and refine their understanding.

Once students feel confident in their understanding, click the orange plus sign on the Desmos dashboard to allow students to progress to **screen 10**. This screen prompts students to leave the Desmos activity and go to the provided link to the GeoGebra activity: geogebra.org/m/a4sm8fc6. In this activity, students are expected to read about and interactively explore the relationship between the Pythagorean Theorem and the equation of a circle.

When students return to the Desmos activity, they must write what they learned from the GeoGebra activity on screen 10. Students' responses are shared with the class upon submission.

5 minutes

# Evaluate

On the Desmos dashboard, click the orange "Edit" button and select screen 11, then click "Restrict to Screen 11." On **screen 11**, have students complete a Card Matching activity to assess their learning individually.

Students are asked to match an equation of a circle with each of the following circles:

- A circle with a radius of 2 and a center at (–2, 3).
- A circle with a center at (2, –3) and passes though (2, –1).
- A circle with a given graph.
- A circle with endpoints of a diameter at (2, 7) and (2, –1).

Use student responses to see which misconceptions persist.

## Resources


- K20 Center. (n.d.). Bell Ringers and Exit Tickets. Strategies. https://learn.k20center.ou.edu/strategy/125
- K20 Center. (n.d.). Card Matching. Strategies. https://learn.k20center.ou.edu/strategy/1837
- K20 Center. (n.d.). Collective Brain Dump. Strategies. https://learn.k20center.ou.edu/strategy/111
- K20 Center. (n.d.). Tell Me Everything. Strategies. https://learn.k20center.ou.edu/strategy/107
- K20 Center. (n.d.). Desmos Classroom. Tech tools. https://learn.k20center.ou.edu/tech-tool/1081
- K20 Center. (n.d.). GeoGebra. Tech tools. https://learn.k20center.ou.edu/tech-tool/2352
- Pixabay. (2016, August 30). Black Ceiling Wall [Photograph]. Pexels. https://www.pexels.com/photo/black-ceiling-wall-161043/