



# Center of Attention

## Writing the Equation of a Circle



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<b>Grade Level</b>	9th – 10th Grade	<b>Time Frame</b>	65 minutes
<b>Subject</b>	Mathematics	<b>Duration</b>	1-2 class period(s)
<b>Course</b>	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

- Lesson Slides (attached)
- Circle Characteristics handout (attached; one per student; printed front only)
- 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)
- Exit Ticket handout (attached; one half-sheet per student; printed front only)
- Pencils
- Coloring utensils (three per student)
- Student devices with internet access (for Extend portion)

10 minutes

## Engage

Introduce the lesson using the attached **Lesson Slides**. Display **slide 3** to show students the essential question. Go to **slide 4** to share the lesson's learning objectives. Review each of these slides with students to the extent you feel necessary.

### Teacher's Note: Preparation

Each student will need three coloring utensils during the Explain portion of the lesson, so be sure to have these supplies on hand. Depending on how you present the lesson, you may have students retrieve their coloring utensils right away or wait until the Explain portion, just before you pass out the **Guided Notes** handout to students.

Go to **slide 5** and pass out the attached **Circle Characteristics** handout to each student. Ask students to use the [Collective Brain Dump](#) strategy to write what they know about circles on the top part of the handout. Have students 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.

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

Display **slide 6**. Ask students to look at the Explore portion of the Circle Characteristics handout and work with their partners to complete it. Have students 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.

25 minutes

## Explain

Display **slide 7** to provide students with the answers to the Explore portion of the Circle Characteristics handout.

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.

### Teacher's Note: Coloring Utensils

If students did not get three coloring utensils each at the beginning of the lesson, have them retrieve these supplies at this time.

Go to **slide 8** and 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.

15 minutes

## Extend

Display **slide 9** and inform students it is time for them to apply what they have learned so far.

Pass out the attached **Writing Equations** handout to each student. Ask students to work in pairs to find the equation of each provided circle.

### Teacher's Note: Scaffolding

The handout requires students to 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.

Transition through **slides 10–11** so students can check their work. Be sure to allow students time to find their mistakes, ask questions, and refine their understanding.

Go to **slide 12** and provide students with the link to the [GeoGebra](https://www.geogebra.org/m/a4sm8fc6) activity: [geogebra.org/m/a4sm8fc6](https://www.geogebra.org/m/a4sm8fc6). Have students read about and interactively explore the relationship between the Pythagorean Theorem and the equation of a circle.

5 minutes

## Evaluate

Use the [Exit Ticket](#) strategy to assess students' learning individually.

Go to **slide 13** and give each student a half-sheet from the attached **Exit Ticket** handout. Then, ask students to match each of the following circles with one of the equations from the right-hand column of the Exit Ticket:

1. A circle with a radius of 2 and a center at  $(-2, 3)$ .
2. A circle with a center at  $(2, -3)$  and passes through  $(2, -1)$ .
3. A circle with a given graph.
4. 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/>