Rotate a Point

1. Open geometricfunctions.org/links/rotate-family/ and tap “Investigate 1.”

 2. To create independent variable *x,* tap the  tool. Click or drag to locate independent variable *x* in the sketch. Then drag *x* around in the sketch.

3. To create a center and angle for rotation, tap the  tool. Click or drag to place center *C*, and click again to place angle measurement *θ*.

**Q1** Drag point *θ* (not the measurement) and notice how its measurement changes. What is the smallest value you can make? What is the largest value you can make?

|  |  |
| --- | --- |
| Smallest value: | Largest value: |

4. Set *θ* to 90°:  .

 5. To rotate *x,* tap the  tool. Attach glowing point *x* to your existing point *x.* The dependent variable, *RC,θ*(*x*), is the “rotation about *C* by *θ* of *x.”*

**Q2** Turn on tracing, vary *x* to make a shape, and draw the traces on the left. (Also show your center and angle value.) Do the same on the right, but use a different angle.

|  |  |
| --- | --- |
| *θ* = | *θ* = |

**Q3** Compare the speed of *x* and *RC,θ*(*x*). Which one is faster, or do they move with the same speed?

(Dragging *C* or *θ* changes the function rule, so turn tracing off when you move them.)

**Q4** Choose a new angle and center point, and trace a new pattern. Try to include fixed points. How many fixed points could you find? Where were they?

|  |  |
| --- | --- |
| *θ* =  My traces: | What I noticed about rotation fixed points: |

**Q5** Set the angle to 90°. Then start with *x* near *C* and drag *x* to the right. Use the first box to draw where *RC,θ*(*x*) went. Fill in the other boxes the same way.

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |

What do you notice about these four patterns?

**Q6** Trace a new pattern using *θ* = 180°. Draw your pattern on the left, and write what you noticed on the right. Don’t forget to mark point *C* in your drawing.

|  |  |
| --- | --- |
| My pattern: | What I noticed: |

**Q7** Change your function to try to match each picture below. In each box, draw a point to show where you put the center, and write the angle you used. Try to match all 5!

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Angle: *θ* = | Angle: *θ* = | Angle: *θ* = | Angle: *θ* = | Angle: *θ* = |

Restrict the Domain

1. Open geometricfunctions.org/links/rotate-family/ and tap “Investigate 2.”

 2. Use the  tool to create an interesting shape for *x* to follow.

3. Use the  tool, attaching independent variable *x* to the polygon. (You already know the three parts of a function—independent variable, rule, and dependent variable—so this sketch has a single Rotate tool to make all three parts.)

4. Use the **Animate** tool to animate variable *x* around the polygon. Because *x* stays attached to the the polygon, the polygon is called the *restricted domain* of *x.*

**Q1** Adjust the shape of the polygon, the center point, and the angle of rotation so the traces make an interesting shape. Draw your picture on the left. (Remember to mark point *C.*) Write the angle and what you noticed or wondered on the right.

|  |  |
| --- | --- |
| My picture: | Angle I used: *θ* =  What I noticed or wondered: |

**Q2** On page 2 use the same tools, but change your polygon shape, your center point, and your angle of rotation to make a different picture.

|  |  |
| --- | --- |
| My picture: | Angle I used: *θ* =  What I noticed or wondered: |

5.On page 3 restrict *x* to the red polygon and construct a rotate function.

6. Adjust the center and angle to make the trace of your dependent variable exactly match the blue polygon.

**Q3** On the picture below, mark where you put the center point, and write down the angle you used. Do the same thing for the polygons on page 4 and page 5.

|  |  |  |
| --- | --- | --- |
| Page 3 | Page 4 | Page 5 |
| Angle of rotation: *θ* = | Angle of rotation: *θ* = | Angle of rotation: *θ* = |

**Q4** On page 6 is a rotation puzzle that has only two points. Try to solve it. Explain below how you figured it out. Include a drawing.

**Q5** On page 7 use the Circle tool, along with your other tools, to make an interesting rotation design that includes at least four rotations. Animate your design, and draw it here.

**Q6** On page 8 there are 8 suspects. You have evidence that the crime was committed by a dependent variable of the rotation family. Your job is to figure out which two suspects belong to the rotation family, and which of them is the dependent variable. Explain in the space below how you found the suspect.

1. Drag *x* up. How does *RC,θ*(*x*) move? (Be specific: describe both the direction and the speed.) Drag *x* left. How does *RC,θ*(*x*) move?
2. Describe the traced shapes. How are they similar, and how are they different? Consider position, size, angle, and anything else you think of. On your paper include a drawing of your two traced shapes.
3. What happened when you went through the center of rotation? Describe these traced shapes, and include a drawing on your paper. Were there any fixed points? If so, where?
4. Drag *x* to the right. Which way does *RC,θ*(*x*) go, and how fast? When you drag *x* up. which way does *RC,θ*(*x*) go? Which way must you drag *x* to make *RC,θ*(*x*) go down?
5. On your paper describe and draw the traced shapes. How are these shapes different from the shapes you made when you rotated by 90°?
6. What happened to *RC,θ*(*x*) as you changed *θ* to 180°?
7. Drag *x* and observe the variables. How do the motions of *x* and *RC,θ*(*x*) compare now? What is similar about the motions, and what is different, from the behaviors you observed earlier?
8. Turn tracing back on and drag *x* to make an interesting shape. How are these new shapes different from the previous shapes? How are they similar?
9. What happens when you set *θ* = 5°? What happens when you set *θ* = 135°?
10. Turn on tracing, drag independent variable *x* and describe the function’s domain. (In other words, where can you drag the independent variable?)
11. How does the trace of *RC,θ*(*x*) (the *range*) compare to the restricted domain? What features of the domain and range are similar, and what features are different?
12. Describe in detail the strategy you used to solve each challenge.

**1.** Describe one important thing you learned today about the rotation function family.

**2.** Describe one thing about the rotation function family that seems confusing to you.