



## Part I: Notice and Wonder

1. Take a minute to carefully look over the image shown.
  - a. What do you notice about this image?

*[Possible student responses.]*

*I notice –*

- *a lot of green circles;*
- *circles inside of squares;*
- *that not all circles are full circles;*
- *the non-irrigated land is very dry;*
- *very small, white buildings.*

- b. What do you wonder?

*[Possible student responses]*

*I wonder –*

- *how big each circle is;*
- *what crop is growing in the circles;*
- *what the circles represent;*
- *why the circles are different shades of green.*

**Grade Band: 9-10**

**Content Addressed:**

**Area of Squares and Circles**  
**Area of Sectors**

**Vocabulary:**

- Circle
- Square
- Irrigation
- Sector
- Concentric

[!\[\]\(1f56542a42e2413e44a2b2023033aa2e\_img.jpg\) \*\*Presentation Slides\*\*](#)

2. What types of math questions could we ask about this image?



*[Possible student responses]*

- *What is the length of a circle's radius, diameter, or circumference?*
- *What is the area of the circle and the square?*
- *What is the side length of the square?*
- *How many circles are in the field?*
- *What is the area of a sector?*
- *What is the ratio of the size of the buildings to a circle?*

## Part II: Scenario and Guiding Questions

Shortly after takeoff from Denver International Airport, Carlos looked out the airplane window and noticed something very interesting: Green crop circles were arranged in a rectangular array! As his plane continued to ascend, Carlos couldn't help but wonder what percentage of the land was dry and brown.

Assume each irrigation unit below is centered in the square and spans the length of 1 radius of the circle.



Refer to the image above for questions 3–5.

3. If the square is 1 mile long on each side, what is the length of the irrigation unit?

*The length of the irrigation unit is 0.5 mile.*

4. What is the area of the crop circle? Use 3.14 for  $\pi$ . Round your answers to the nearest thousandth of a unit.

*The area of the crop circle is approximately 0.785 square mile.*

5. In each square mile with a full crop circle, what percentage of the land is not irrigated? Round your answer to the nearest tenth of a percent.

*Approximately 21.5 percent of the land is not irrigated. If each square is 1 mile long, then each square has an area of 1 square mile. Since the area of a full crop circle is approximately 0.785 square mile, that means approximately 0.215 square mile of each square mile is not being irrigated.*

## AREA OF SECTOR

Carlos noticed that one particular crop formation wasn't a complete circle. He quickly estimated that about  $\frac{5}{8}$  of the whole circle was irrigated. This is called a *sector*.



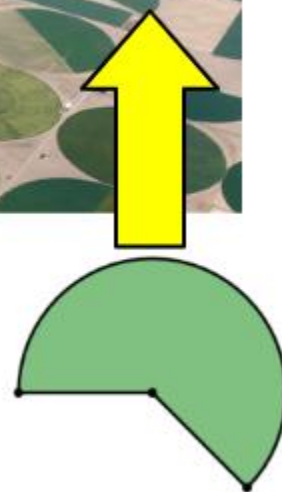
For questions 6 and 7, focus on the crop circle indicated by the arrow above.

6. What is the area of the sector? Use 3.14 for  $\pi$ . Round your answers to the nearest thousandth of a square mile.

*The area of the sector is approximately 0.491 square mile.*

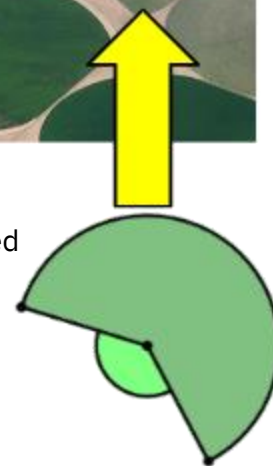
7. How many degrees does the irrigation unit rotate from start to finish?

*The irrigation unit rotates 225 degrees from start to finish.*





Carlos noticed a different interesting crop formation that he realized was formed by two concentric irrigation units. He again quickly estimated that the larger irrigation unit irrigated about  $\frac{2}{3}$  of the whole circle. He also estimated the smaller circle's irrigation unit had a radius that was about  $\frac{2}{5}$  of the length of the larger circle's radius.



For questions 8 and 9, focus on the crop circle indicated by the arrow.

8. What is the length of the radius of the smaller irrigation unit?

*The smaller irrigation unit's radius is 0.2 mile.*

9. What is the total area being irrigated in this crop circle? Use 3.14 for  $\pi$ . Round your answers to the nearest thousandth.

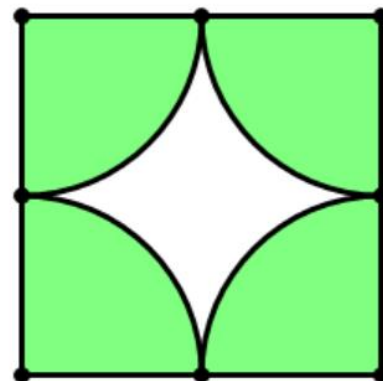
*The total area being irrigated is approximately 0.565 square mile:  $\pi \times (0.5)^2 \times \frac{2}{3} + \pi \times (0.2)^2 \times \frac{1}{3}$ .*

## Extension

Carlos wondered if there was a different way farmers could design the irrigation systems so that a higher percentage of the land was irrigated. He imagined a setup in which the irrigation unit rotated 90 degrees, centered at each corner of the land. Each plot of land would then need four separate irrigation units, each with a radius of 0.5 mile (as shown).

10. Would this irrigation system cover more or less than the original setup, with the circle in the center of the square?

*It covers the same amount.*



Name \_\_\_\_\_

## Notice and Wonder: Irrigation



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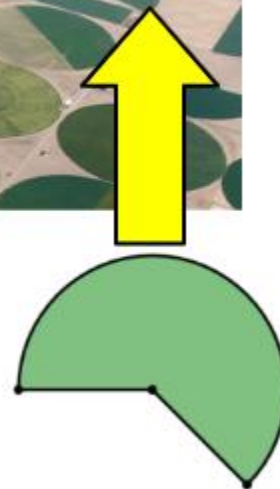
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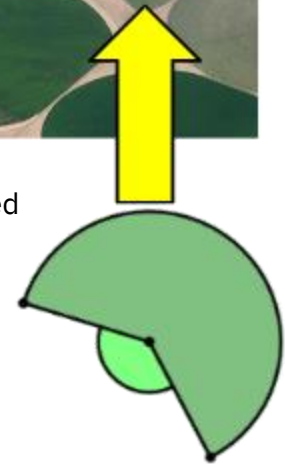
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7. How many degrees does the irrigation unit rotate from start to finish?



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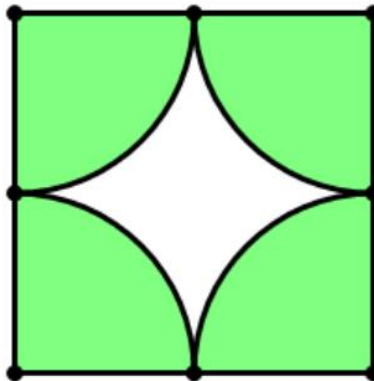


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**EXTENSION:**

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