Essential Question:
How do I graph a polar equation without a calculator?
11.4 Polar Graphs Day 2

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Tell what type of graph it is, make a table, and sketch a graph.

1. \( r = -4 \cos \theta \)

- circle on x-axis reflected
### 11.4 Polar Graphs Day 2

**Essential Question:** How do I graph a polar equation without a calculator?

Tell what type of graph it is, make a table, and sketch a graph.

2. \( r = 2 + 4 \sin \theta \)

Where does the loop begin?

\[
\begin{align*}
0 &= 2 + 4 \sin \theta \\
\frac{1}{2} &= \sin \theta \\
\sin^{-1} \left( \frac{1}{2} \right) &= \theta \\
\frac{\pi}{6} &= \theta
\end{align*}
\]

Where does the loop end?

Where does the loop end?
11.4 Polar Graphs Day 2

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3. \( r = \sin(2\theta) \)

Rose w/ 4 petals

Where do the petals begin & end?

\[
\theta = \frac{\pi}{2} \\
\frac{\pi}{2} \leq \theta \leq \frac{3\pi}{2}
\]
Essential Question: How do I graph a polar equation without a calculator?

Tell what type of graph it is, make a table, and sketch a graph.

4. \( r = 5 \cos(3\theta) \)

Rose w/ 3 petals

Where do the petals begin & end?

\[
\cos^{-1}(0) = 3\theta
\]

\[
\frac{\pi}{6} + \frac{\pi}{3} n
\]

\[
\theta
\]

\[
\theta = \frac{\pi}{3}
\]
Some Common Polar Curves

Circles and Spiral

- \( r = a \) circle
- \( r = a \sin \theta \) circle
- \( r = a \cos \theta \) circle
- \( r = a\theta \) spiral

Limaçons

- \( r = a \pm b \sin \theta \)
- \( r = a \pm b \cos \theta \)
  \((a > 0, b > 0)\)
  Orientation depends on the trigonometric function (sine or cosine) and the sign of \( b \).
  
  \( a < b \) limaçon with inner loop
  \( a = b \) cardioid
  \( a > b \) dimpled limaçon
  \( a \geq 2b \) convex limaçon

Roses

- \( r = a \sin n\theta \)
- \( r = a \cos n\theta \)
  \( n \)-leaved if \( n \) is odd
  \( 2n \)-leaved if \( n \) is even

  \( r = a \cos 2\theta \) 4-leaved rose
  \( r = a \cos 3\theta \) 3-leaved rose
  \( r = a \cos 4\theta \) 8-leaved rose
  \( r = a \cos 5\theta \) 5-leaved rose

Lemniscates

Figure-eight-shaped curves

- \( r^2 = a^2 \sin 2\theta \) lemniscate
- \( r^2 = a^2 \cos 2\theta \) lemniscate