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Modeling Solar Eclipse Geometry

We can demonstrate the geometry and timing of this by just plotting a few points on a piece of graph paper, and using quarters and a nickel to represent the Sun and Moon (not to scale). Depending on the location of the observer on Earth, you may experience a total solar eclipse, a partial solar eclipse, or no eclipse at all. This depends on if the Moon and the Sun cross paths at the same time in the sky and the location of the Moon in its orbit.

- Set up your graph:
    1. We will only be plotting in Q1 so use the entire graph paper for that quadrant.
    2. Mark the Origin (0,0) and use the ruler to draw the respective X and Y axis lines.
    3. Mark every other line and number the axes 1, 2, 3... up to 10.

- **Model 1 - Moon at Perigee**
  Perigee is where the Moon is closest to Earth in its orbit. Use the quarter-sized disks to represent the Sun and Moon, as the Moon appears bigger in the sky at perigee.
    1. Plot the following 5 points for the Sun's path:
        - Sun 1: (1,4)
        - Sun 2 : (3,4)
        - Sun 3: (5,4)
        - Sun 4: (7,4)
        - Sun 5: (9,4)
    2. Label the points respectively: s1, s2, s3, s4, s5.
    3. Use the ruler ruler to draw a straight line through the points. Label this line 'Sun Path'
    4. Plot the following 5 points for the Moon's path:
        - Moon 1: (1,8)
        - Moon 2: (3,6)
        - Moon 3: (5,4)
        - Moon 4: (7,2)
        - Moon 5: (9,0)
    5. Label the plots respectively, m1,m2,m3,m4,m5.
    6. Use the ruler to draw a straight line through the points. Label this line 'Moon Path'
    7. Place the disk representing the Sun on s1 of the Sun path, and the disk representing the Moon on m1 of the Moon path.

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8. Move both disks simultaneously from s1 to s2 and m1 to m2.
9. Now, from s2 to s3 and m2 to m3.
10. Then, from s3 to s4 and m3 to m4.
11. Next, from point s4 to s5 and m4 to m5.
12. **Record your observations at each point in the Data Table 1.**

Data Table 1		
Point	**Does an eclipse occur? Total or Partial?**	**Reasoning**
(s1, m1)		
(s2, m2)		
(s3, m3)		
(s4, m4)		
(s5, m5)		

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- **Model 2 - Moon at Apogee**
  1. Repeat the steps from Model 1, using the nickel-sized disk for the Moon this time.
  2. **Record your observations at each point in Data Table 2.**

Data Table 2		
Point	**Does an eclipse occur? Total or Partial?**	**Reasoning**
(s1, m1)		
(s2, m2)		
(s3, m3)		
(s4, m4)		
(s5, m5)		

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- **Model 3 - Other positions**

  Sometimes, even though the path of the Moon crosses the path of the Sun in the sky, the Moon is either too early or too late to have them overlap. Use the quarter-sized disk for the Moon.

  1. Place the Sun at point: s1.
  2. Place the Moon at point: m2.
  3. Move both disks simultaneously from s1 to s2 and m2 to m3.
  4. Then from s2 to s3 and m3 to m4.
  5. Then from s3 to s4 and m4 to m5.
  6. **Record your observations at each point in Data Table 3.**

Data Table 3		
Point	**Does an eclipse occur? Total or Partial?**	**Reasoning**
(s1, m2)		
(s2, m3)		
(s3, m4)		
(s4, m5)		

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Now that you have graphed your data, answer the following questions.

1. In order for a total eclipse to occur, describe the position of the Sun, Earth, and Moon.

2. Explain what factors need to be in place for a total eclipse to occur

3. Describe the position of the Sun, Earth, and Moon in order for a partial eclipse to occur.