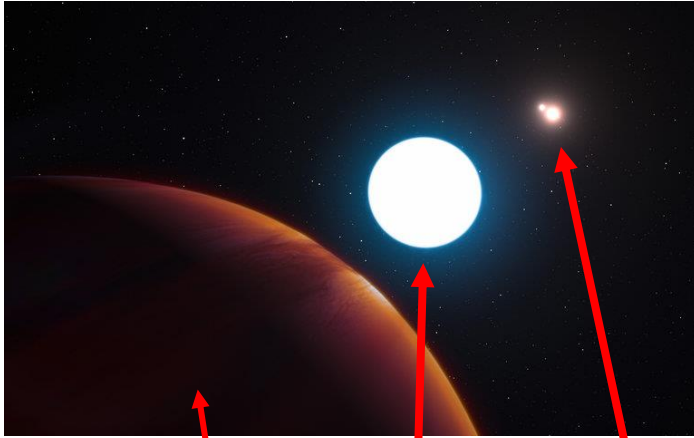


# CENTRIPETAL FORCE/KEPLER'S 3<sup>RD</sup> LAW Unit 14

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## Planet Where Sunsets Are 3 Times as Nice



An artist's rendition of the gas giant HD 131399Ab, which belongs to a triple-sun system 320 light years from Earth.

Astronomers have discovered a planet with an exotic sight on its horizon: a triple sunset.

The planet, **HD 131399Ab** is a gas giant in a system with three stars some 320 light years away in the Centaurus Constellation. The **(((main star it orbits is nearly twice as massive as the sun. NASA site states the star is 80% more massive than our own sun.)))** The other two stars in the system are smaller and much closer together. They move around each other like a spinning dumbbell.

It **(((takes HD 131399Ab about 550 Earth years to orbit its star)))** — a trek that is more than double Pluto's journey around our sun. For half the planet's trip it experiences impressive triple sunsets. Then for the other half, the main sun and the smaller ones set at opposite times, creating perpetual daylight. Astronomers found the planet using the [European Southern Observatory's Very Large Telescope](#) in northern Chile. It is the first exoplanet with a wide orbit ever found within a triple star system, they reported Thursday in the journal [Science](#). HD 131399Ab is only about 16 million years old, which makes it one of the youngest exoplanets ever discovered. It is also about four times as massive as Jupiter, and has temperatures that reach more than 1,000 degrees Fahrenheit.

**INTRODUCTION:** The LA Times on July 8, 2016 also wrote about this strange planet with three suns using NASA data. **(((NASA stated the planet is 80 times ( 80 R<sub>ES</sub>) the distance between the earth and the sun from the largest star in the system.)))** The goal of this application is to verify the mass of this exoplanet's larger star is ~ 1.8 the mass of the earth's sun using kepler's 3<sup>rd</sup> law:

$$M = (R^3/T^2) (4 \pi^2/G)$$

where T = period of HD 131399Ab about the larger star = 550 years, G = gravitational constant = 6.67 X 10<sup>-11</sup> N m<sup>2</sup> / kg.<sup>2</sup>.

**QUESTIONS:** (a) Convert period of 550 years into seconds? , (b) Find R = 80 R<sub>ES</sub> ...the distance the exoplanet HD 131399Ab is from it's largest main sun? Find this distance in meters. (c) Using kepler's 3<sup>rd</sup> law find mass of main star of this triplet of three stars? , (d) It is stated in the article the mass of this main star is 80% more than earth's sun. Find mass M of this main star (of the triplet) using 1.8 M<sub>SUN</sub> ? (e) How does (c) & (d) compare?

**HINTS:** Earth sun distance R<sub>ES</sub> = 1.5 X 10<sup>11</sup> meters ,  $\pi = 3.1416$  , M<sub>SUN</sub> = 2 x 10<sup>30</sup> kg.

**ANSWERS:** (a) 1.73 X 10<sup>10</sup> s, (b) 1.20 X 10<sup>13</sup> meters , (c) ~3.415 X 10<sup>30</sup> kg. , (d) 3.6 X 10<sup>30</sup> kg. , (e) Within 5 % , close