

# CENTRIPETAL FORCE FROM GRAVITY

Unit 14

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## NASA and SpaceX Delay Launch of TESS, a New Planet Hunter

By DENNIS OVERBYE APRIL 16, 2018

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### How NASA's TESS Spacecraft Will Hunt Exoplanets

NASA's TESS spacecraft will spend two years searching the sky for nearby alien worlds. By DENNIS OVERBYE, JONATHAN CORUM and JASON DRAKEFORD

on Publish Date April 16, 2018. Photo by NASA Goddard Space Flight Center/Conceptual Image Lab. [Watch in Times Video](#) » The search for alien worlds and perhaps alien life will take another step outward this week when [TESS, the Transiting Exoplanet Survey Satellite](#), is launched into orbit around the Earth. TESS will spend at least two years scrutinizing the entire sky for exoplanets — planets around other stars — within about 300 light years from here. The worlds next door

**When is the launch and how can I watch it?** The launch was postponed from Monday, and rescheduled for Wednesday. It should be available on NASA's website [nasa.gov/live](http://nasa.gov/live).

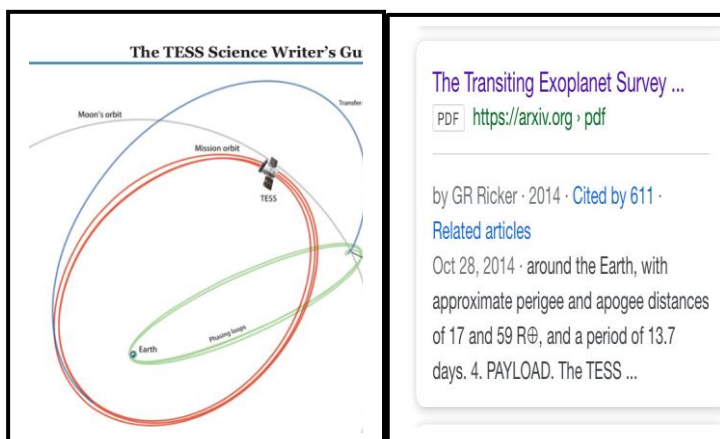
SpaceX, whose rocket will carry TESS into space, said on Twitter that additional guidance and navigation work was needed before the spacecraft could be launched. [NASA said that TESS](#) is in "excellent health, and remains ready for launch."

### Why is the TESS mission important?

Over the last 30 years, astronomers on Earth and in space, using instruments like the Kepler spacecraft, have discovered 4,000 exoplanets, most of them far, far away. The galaxy, they now think, has [more planets than stars in it](#). TESS will find the closest of these planets to Earth, pinpointing targets for the next generation of telescopes, like the James Webb Space Telescope, in space to study for clues to their habitability or even inhabitants. TESS is sponsored by NASA, as part of its small Astrophysics Explorer missions. The spacecraft was designed by a collaboration led by George Ricker of the Massachusetts Institute of Technology and built by Orbital ATK of Dulles, Va. It will be launched in a SpaceX Falcon 9 rocket.

### Where will it go?

TESS will be launched into an unusual egg-shaped orbit that takes it as far out as the moon every **13.7 days (period T)** and then back down to **67,000 miles altitude, from where it will transmit data.**



**INTRODUCTION:** Gravity provides needed centripetal force to keep TESS satellite telescope in orbit about the earth (see graphic at far left). The orbit is quite elliptical with apogee (close point 17 earth radius = A) and perigee (far point 59 earth radius = P) listed in middle box from NASA as listed in middle box at left.  
 $mv^2/R = G mM/R^2$  where  $v = R\omega = 2\pi R/T$ , thus  
 $4\pi^2 R/T^2 = G M/R^2$ ,  $[4\pi^2/G][R^3/T^2] = M$   
 $R = \text{semimajor axis} = [A + P]/2 = (76 R_{\text{EARTH}})/2$

**QUESTIONS:** (a) Find R (semimajor axis) in meters? (b) Find period of orbit (13.7 days seen at left) in seconds? (c) Find mass of earth?, (d) How does your computation for Earth mass in (c) compare with NASA value for earth Mass =  $5.972 \times 10^{24}$  kg. ?

**HINTS:**  $R_{\text{EARTH}} = 6.3781 \times 10^6$  m., G = gravitational constant =  $6.67 \times 10^{-11}$  N m<sup>2</sup>/kg<sup>2</sup>, 3600 s./hr., 24 hrs/day

**ANSWERS:** (a)  $R = 2.425 \times 10^8$  meters., (b)  $T = 1.184 \times 10^6$  seconds, (c)  $M_{\text{EARTH}} = 6.015 \times 10^{24}$  kg. (d) Compared and NASA value for earth mass are quite close. Kepler's third law works well. Thankyou Kepler!