

# CENTRIPETAL FORCE

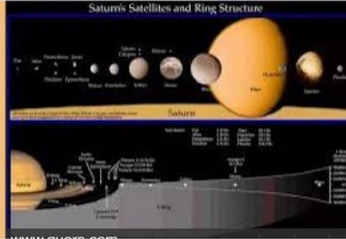
Unit 14, Dr. John P. Cise, Professor of Physics, Austin Com. College,

Austin Texas. USA [jpcise@austincc.edu](mailto:jpcise@austincc.edu) & NYTimes, June 27, 2019 by David W Brown. Dedicated to Bill Nye, The Science Guy

## NASA Announces New Dragonfly Drone Mission to Explore Titan



An animated impression of the Dragonfly rotorcraft entering the atmosphere of Titan and then landing on its surface.



Titan orbits Saturn at a mean distance of 1,221,850 km (759,220 miles), taking 15.94 Earth days for one revolution.

**INTRODUCTION:** Kepler's 3<sup>rd</sup>. Law is  $M = [4\pi^2][R^3/T^2]$ , Goal Here is confirm mass of Saturn as  $5.67 \times 10^{26}$  kg. from NASA.

**QUESTIONS:** (a) Find period T In seconds?, Ans:  $1.377 \times 10^6$  s. (b) Confirm mass of Saturn?

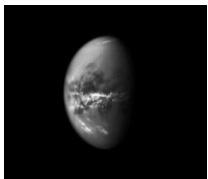
**HINTS:** 24 hrs./day, 3600 s./day

The quadcopter was selected to study the moon of Saturn after a "Shark Tank"-like competition that lasted two and a half years. NASA announced Thursday that it is sending a drone-style quadcopter to Titan, Saturn's largest moon. Dragonfly, as the mission is called, will be capable of soaring across the skies of Titan and landing intermittently to take scientific measurements, studying the world's mysterious atmosphere and topography while searching for hints of life on the only world other than Earth in our solar system with standing liquid on its surface. The mission will be developed and led from the Applied Physics Laboratory at Johns Hopkins University in Laurel, Md. "This revolutionary mission would have been unthinkable just a few years ago," said Jim

Bridenstine, the administrator of NASA, in [a video statement announcing the mission](#). **(The spacecraft is scheduled to**

**launch in 2026)).** Once **(at Titan in 2034)),** Dragonfly will have a life span of at least two-and-a-half years, with a battery that will be recharged with a radioactive power source between flights. Cameras on Dragonfly will stream images during flight, offering people on Earth a bird's-eye view of the Saturn moon. "We will be flying initially over dunes and then into rugged terrain," said Elizabeth Turtle, who will lead the mission for the lab as its principal investigator. "We will take images with both downward-looking cameras along the ground track underneath Dragonfly as we fly over the surface, as well as forward-looking cameras, so we'll be able to look out toward the horizon as well." Titan has long intrigued planetary scientists. On Christmas Day 2004, [NASA's Cassini spacecraft](#) sent a probe, Huygens, to the moon's surface. It landed in one piece, revealing a world analogous to a primordial Earth — Dr. Turtle described it as, "eerily familiar on such a different and exotic world." **Rather than water, Titan's seas are filled with liquid methane.** In addition to a camera, Dragonfly will carry an assortment of scientific instruments: spectrometers to study Titan's composition; a suite of meteorology sensors; and even a seismometer to detect titanquakes when it lands on the ground. Drills in the landing skids will collect samples of the Titan surface for onboard analysis. "Titan is an incredibly unique opportunity scientifically," Dr. Turtle said in an interview in April before NASA's announcement. **Not only is it an ocean world — an icy satellite with a water ocean in its interior — but it is the only satellite with an atmosphere. And the atmosphere at Titan has methane in it, which leads to all sorts of rich organic chemistry happening at even the upper reaches of the atmosphere."**

Titan, captured by NASA's Cassini spacecraft. Credit NASA



Part of the Dragonfly mission is to study whether the moon of Saturn could now be, or once was, home to life. Because of the nature of its atmosphere, Titan is a very Earthlike place. Chemically, it is very much like our world's primordial past. The surface pressure of Titan is one-and-a-half times the surface pressure of Earth, and the same sorts of interactions between air, land and sea take place. Titan thus has familiar geology. Methane on Titan plays the role that water plays here. Its methane cycle is analogous to Earth's water cycle. It has methane clouds, methane rain and methane lakes and seas on the surface. The rotorcraft comes after years of studying alternative concepts for studying Titan, such as a conventional orbiter or lander, a hot-air balloon and even a boat. Because it takes about two hours for a signal from Earth to reach Titan, **Dragonfly is designed to fly and land autonomously; onboard hazard-detection will keep it safe**

Dragonfly is similar in size to a Mars rover, or about the **size of a large lawn mower**. Where a Mars rover is limited to inching forward over a decade or longer, however, for the Dragonfly team, Titan's sky and the drone's nuclear fuel source are the limit. NASA has announced other new missions recently.