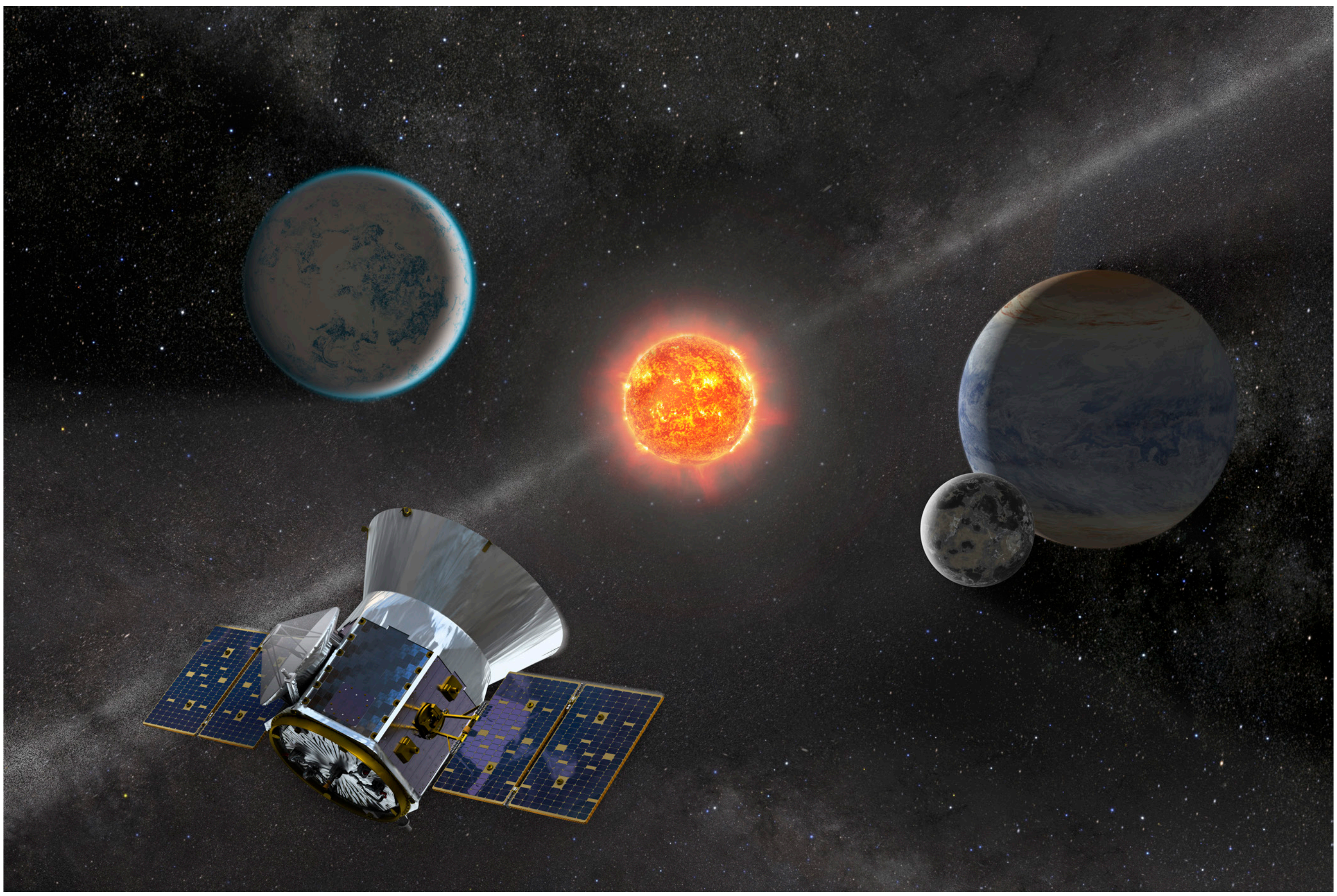
National Aeronautics and Space Administration

# The TESS Science Writer's Guide



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*Front Cover: The Transiting Exoplanet Survey Satellite (TESS) is shown at work in this illustration. TESS will discover thousands of exoplanets in orbit around the brightest dwarf stars in the sky in a two-year survey of the solar neighborhood. TESS will monitor stars for periodic drops in brightness caused by planetary transits. This spaceborne near-all-sky transit survey will identify planets ranging from Earth-sized to giant planets around a wide range of star types and orbital distances.* *NASA's Goddard Space Center/CI Lab*

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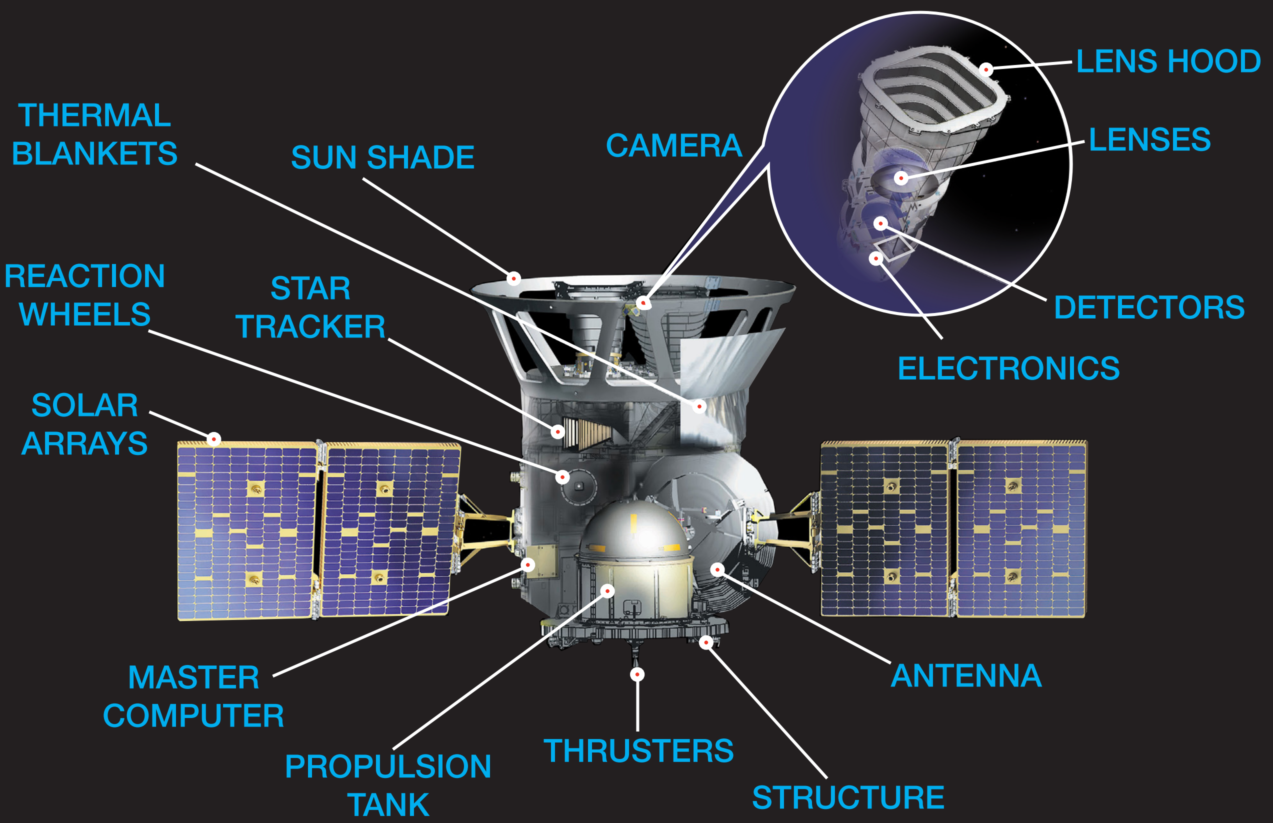
# TESS

## TRANSITING EXOPLANET SURVEY SATELLITE

## ANATOMY OF THE SPACECRAFT




### SUN SHADE
Protects the cameras from the Sun's heat. Keeping the camera temperature stable is critical for finding exoplanets.

### THERMAL BLANKETS
Wrap the exterior of the spacecraft to keep out the Sun's heat. Heaters and thermostats control the temperature inside the spacecraft.

### STAR TRACKER
A camera that takes pictures of the stars to help the spacecraft understand where it is pointed.

### REACTION WHEELS
Four spinning reaction wheels allow the spacecraft to rotate in three dimensions. This enables TESS to maintain precise pointing during data collection and to orient the antenna to Earth during data downlink.

### SOLAR ARRAYS
Use the Sun's energy to generate 390 watts of electricity to power the spacecraft.

### MASTER COMPUTER
Controls operation of all spacecraft components, and stores data that need to be transmitted to the ground.

### PROPULSION TANK
Holds the fuel (called hydrazine) for the spacecraft to use over the lifetime of the mission to achieve and maintain its orbit.

### THRUSTERS
Five small thrusters on the bottom deck propel the spacecraft during orbital maneuvers.

### STRUCTURE
Skeleton around which the spacecraft is built. It is strong enough to ensure the spacecraft survives the stresses of launch.

### ANTENNA
Transmits data collected by the cameras to Earth every two weeks.

### CAMERA
Four cameras will study a combined 24 x 96 degree field of view looking for drops in light levels that indicate planetary transits.

### LENS HOOD
Prevents stray light from reaching the detectors and making transits harder to find.

### LENSES
Seven stacked lenses in each camera bring the light from distant stars into focus on the detectors.

### DETECTORS
Four charge-coupled devices (CCDs) in each of the four cameras turn photons from stars into electrons that we can measure.

### ELECTRONICS
Collect data from the detectors and send it to a computer on the spacecraft for storage and transmission to Earth.

# TESS: Key Points and Science Objectives

The Transiting Exoplanet Survey Satellite (TESS) will discover thousands of exoplanets in orbit around the brightest dwarf stars in the sky. In a two-year survey of the solar neighborhood, TESS will monitor the brightness of stars for periodic drops caused by planet transits. The TESS mission is expected to find planets ranging from small, rocky worlds to giant planets, showcasing the diversity of planets in the galaxy.

**TESS is NASA's next planet finder mission that:**

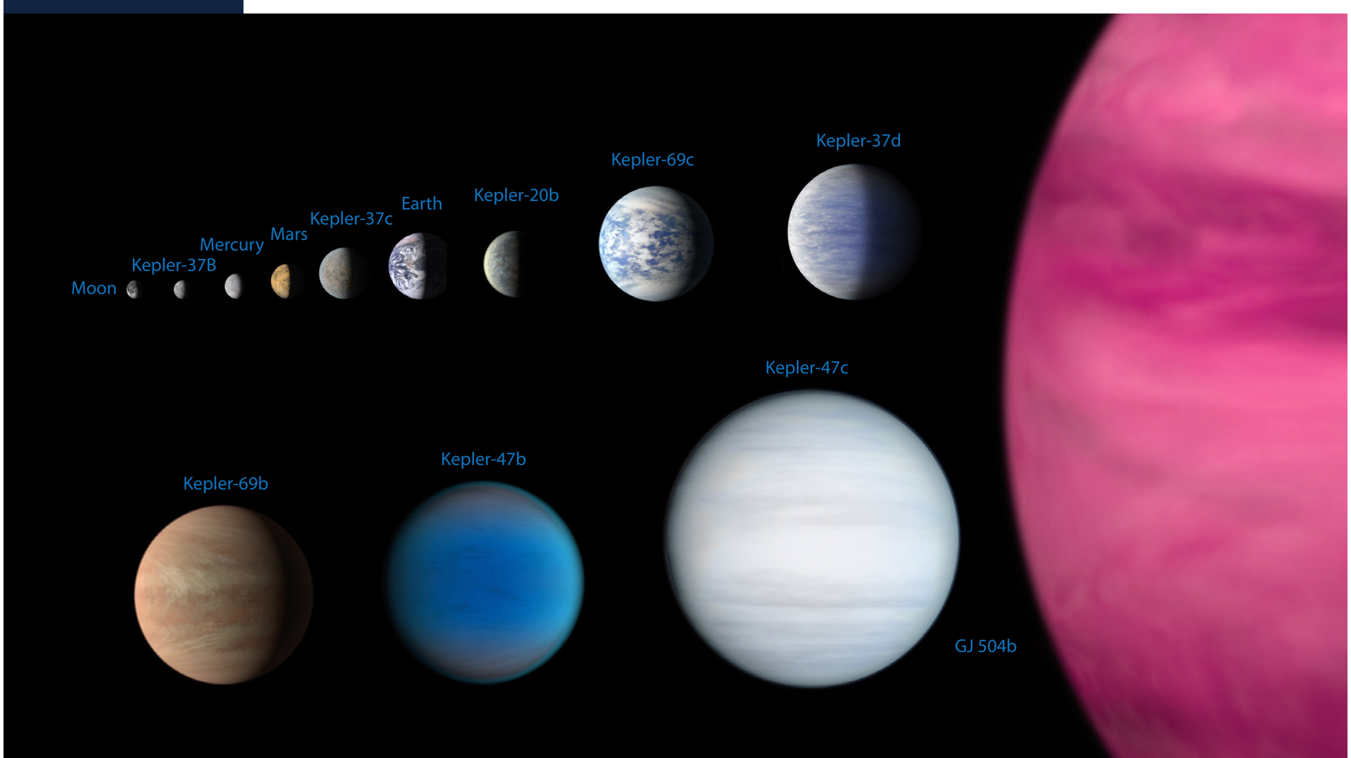
1. **…will find new planets for us to study over the next two decades.**

   NASA selected TESS for launch in 2018 as an Astrophysics Explorer mission to find potential planets orbiting bright host stars relatively close to Earth.

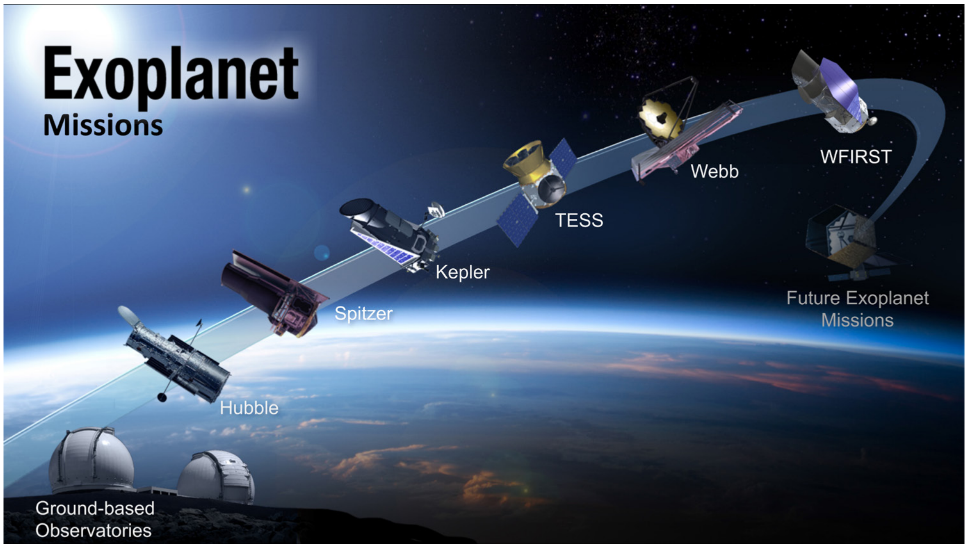
   The mission will search for tell-tale drops in the brightness of stars that indicate an orbiting planet regularly transiting across the face of its star.

   TESS is expected to catalog more than thousands of exoplanets, including hundreds that are less than twice the size of Earth.

   The TESS mission will showcase the diversity of planets in the galaxy, and is expected to find planets ranging from small, rocky worlds to giant planets.




*This illustration shows the relative sizes of exoplanets compared to Earth and the Moon.*
*NASA's Goddard Space Flight Center*



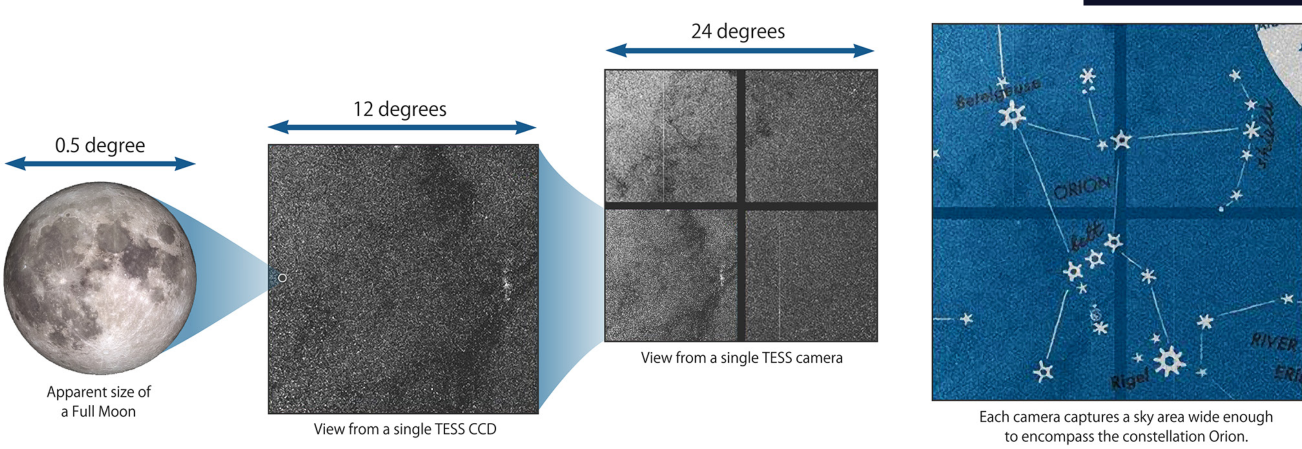

*NASA's current and future exoplanet missions.* NASA

2. **…is designed to detect transiting exoplanets orbiting nearby, bright dwarf stars.**

   A sample of hundreds of thousands of stars must be searched in order to detect a large sample of exoplanets, with an emphasis on discovering Earth-sized and super-Earth planets in the solar neighborhood. Because TESS target stars are, on average, relatively bright, it will be possible to follow up TESS discoveries with ground-based spectroscopy to measure planet masses, and with space-based spectroscopy to characterize their atmospheres.

3. **…is the first spaceborne mission to search nearly the entire sky for exoplanets.**

   NASA's Kepler mission kept its telescope constantly fixed on one small section of the sky during its prime mission, with a goal of determining the frequency of exoplanets. The TESS survey will search an area some 350 times larger, covering more than 85 percent of the sky over two years.




*Each CCD in the TESS cameras images a sky area that could hold 576 full Moons. Each camera images an area as large as the constellation Orion.* MIT

TESS will map the southern sky in the first year and the northern sky in the second year.

The TESS science instrument includes four wide-field CCD cameras. Each camera uses four CCDs and features a lens assembly with seven optical elements that creates a 24-by-24 degree field of view.

Over the two-year mission, TESS will employ a "stare and step" observation strategy. The four cameras will observe a 24-by-96-degree observation sector for 27 days, then the spacecraft will be reoriented to observe the next sector. The cameras will tile the sky with 13 observation sectors in each hemisphere, or a total of 26 observation sectors over the two-year mission.

TESS has two data collection modes: "postage stamp" images that capture light from individual stars and full-frame images that cover the entire field of view. During an observation sector, 15,000 stars selected from a carefully curated list of 200,000 stars make up the primary targets for exoplanet detection, and TESS will record their brightness every two minutes. Images covering the entire 24-by-96-degree field of view will be acquired at 30-minute intervals. Exoplanets will be found using both data products.

**4. …is part of a large exoplanet mission arc.**

The primary goal of TESS is to identify a large sample of small planets where follow-up observations are feasible with current and planned telescopes. TESS will identify small planets and measure their sizes. Through follow-up observations we can determine the masses of some of these planets. With both mass and size measurements we can determine their densities and start to understand what these planets are made of. This work will provide a foundation for future missions in the search for potentially habitable planets.

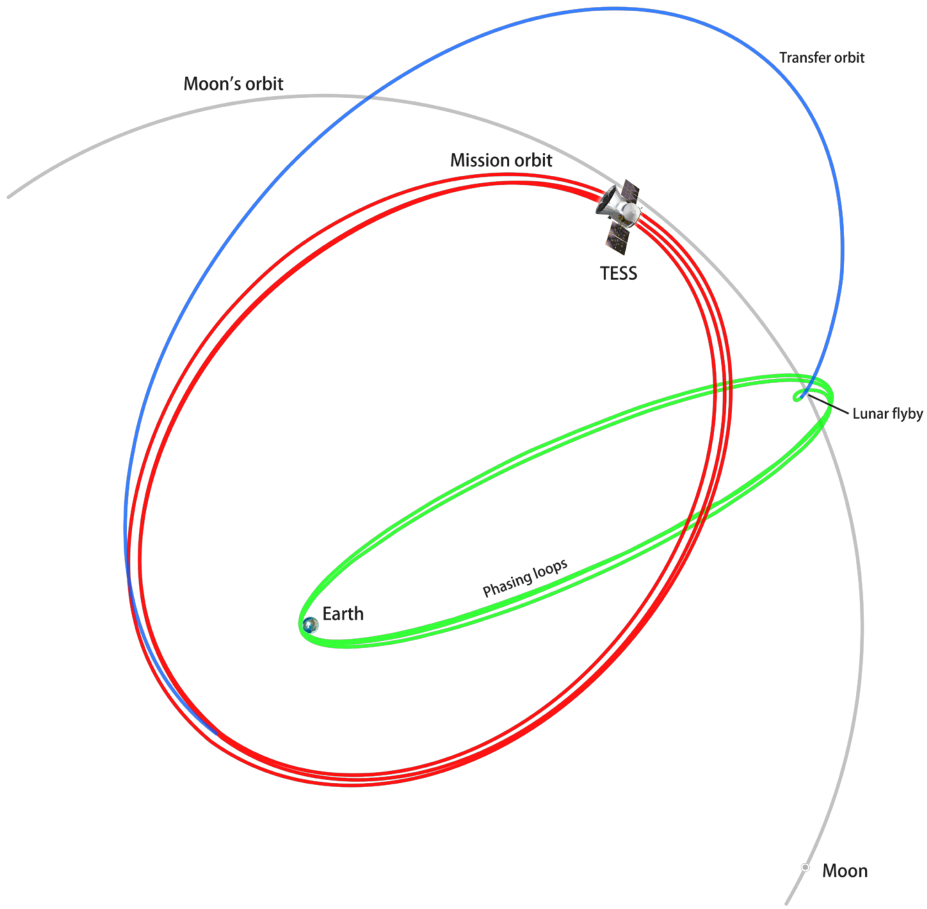
The James Webb Space Telescope is scheduled to launch in 2020, providing a unique opportunity for in-depth study of the planets TESS finds.

The European Space Agency is scheduled to launch the CHaracterising ExOPlanets Satellite (CHEOPS) in 2018 to search for transits around stars already known to host planets. NASA will follow with the Wide Field Infrared Survey Telescope (WFIRST) mission in the mid-2020s. WFIRST will be able to discover and characterize exoplanets with longer orbits as well as planetary disks, complementing TESS findings.

**5. ...complements other key NASA missions in the search for new exoplanets.**

TESS will expand on the Kepler mission's census of exoplanets by targeting closer, brighter stars, where follow-up observations are easier to make. The stars TESS studies will on average be 30 to 100 times brighter than the stars Kepler surveyed.

The TESS mission will find exoplanet candidates that the Webb and Hubble space telescopes and ground-based observatories can study in detail to determine specific properties, such as mass, density and atmospheric composition.




*TESS will fly a never-before-used highly elliptical orbit that completes one circuit every 13.7 days, or half the orbital period of the Moon. After launch, TESS will undertake a series of eccentric phasing loops (green) that culminate in a lunar flyby, where a gravitational assist places the spacecraft on a transfer orbit (blue) with greatly increased inclination. An adjustment during the transfer orbit places TESS in its 13.7-day mission orbit about 60 days after launch. Science operations begin shortly thereafter.* NASA

**6. …will maintain NASA's momentum in the search for exoplanets and life.**

With a launch scheduled for no earlier than April 16, 2018, TESS follows up on the enormous success of the Kepler mission, which has found 2,300 confirmed exoplanets and nearly 4,500 candidates to date.

TESS will build on Kepler's success, locating worlds orbiting much closer and brighter stars that will make ground-based study of these planets easier. By launching before the James Webb Space Telescope, TESS will have time to develop a list of nearby exoplanet targets that will best exploit Webb's capabilities once it begins work.

**7. …features a unique orbit for optimum data collection.**

TESS will operate on a unique high Earth orbit in a 2:1 resonance orbit with the Moon, which has never been used before.

The orbit was tailored for the TESS mission by engineers at NASA's Goddard Space Flight Center and The Aerospace Corporation.

TESS will move on a highly eccentric orbit around Earth that lasts about 13.7 days, half the period of the Moon's orbit around Earth.

This orbit maximizes the amount of sky the TESS spacecraft can image, allowing its cameras to monitor their targets continuously from a stable orbit for the duration of the mission. The orbit also keeps the spacecraft in a safe thermal and radiation environment.

The spacecraft will transmit data each time it is closest to Earth, still about 67,000 miles (108,000 km) away. This is nearly 30 percent of the distance to the Moon and about 45,000 miles (72,000 km) higher than geosynchronous orbit, where most communications satellites operate.

**8. …has a network of important partnerships.**

TESS is led by the Massachusetts Institute of Technology (MIT) Kavli Institute for Astrophysics and Space Research and Principal Investigator Dr. George Ricker.

TESS team partners also include NASA's Goddard Space Flight Center, MIT's Lincoln Laboratory, Orbital ATK, NASA's Ames Research Center, the Harvard-Smithsonian Center for Astrophysics, and the Space Telescope Science Institute (STScI).

# TESS Quick References

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# TESS Related Publications

TESS NASA Fact Sheet
**https://tess.gsfc.nasa.gov/documents/TESS_FactSheet_09-2015-web.pdf**

# TESS Social Media

NASA TESS Facebook: **https://www.facebook.com/NASATESS**
NASA TESS Twitter: **https://twitter.com/NASA_TESS**
MIT TESS Twitter: **https://twitter.com/TESSatMIT**
NASA Goddard Facebook: **https://www.facebook.com/NASAGoddard/**

NASA Goddard Twitter: **https://twitter.com/NASAGoddard**
NASA Goddard YouTube: **https://www.youtube.com/user/NASAexplorer**

## TESS Media Resources

TESS digital media archive: **https://svs.gsfc.nasa.gov/Gallery/TESS.html**

## Media Contacts

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## TESS Websites

Main NASA TESS website: **https://www.nasa.gov/tess**
MIT TESS website: **https://tess.mit.edu/**
NASA TESS project website: **https://tess.gsfc.nasa.gov/**
NASA TESS digital archive: **https://svs.gsfc.nasa.gov/Gallery/TESS.html**
TESS Guest Investigator program website:
**https://heasarc.gsfc.nasa.gov/docs/tess/**

## General Exoplanet Resources

Exoplanet Exploration website: **https://exoplanets.nasa.gov/**
NASA Exoplanet Exploration facebook:
**https://www.facebook.com/NasaPlanetquest/**
NASA Exoplanet Exploration twitter: **https://twitter.com/PlanetQuest**

## TESS Q&A: Mission and Science

**What does TESS stand for?**
Transiting Exoplanet Survey Satellite

**What is the purpose of the TESS mission?**
TESS will discover thousands of exoplanets in orbit around the brightest dwarf stars in the sky. In a two-year survey, TESS will monitor for periodic drops in brightness caused by planetary transits. This first-ever spaceborne near-all-sky transit survey will identify planets ranging from Earth-sized to giant planets around a wide range of star types and orbital distances.

**What is an exoplanet?**
A planet orbiting a star other than the Sun.

**What is a transit?**
A transit occurs when a planet's orbit carries it directly in front of its parent star as viewed from the observer's perspective. This results in a temporary and periodic drop in the star's brightness. Thousands of exoplanets have been discovered through this method, and thousands of additional candidates await confirmation, largely thanks to NASA's Kepler mission.

**What is a habitable zone?**
The range of distances from a star where temperatures allow liquid water to persist on a planet's surface, given a suitable atmosphere. Since water is necessary for life as we know it, its presence is required for worlds to be considered capable of supporting life.

**What is transit photometry?**
Monitoring the change in brightness of a star as an orbiting planet passes in front of it. Like NASA's Kepler and K2 missions, TESS will use this method to find exoplanets. Transits typically last from 1 to 10 hours. Most transits from planets TESS will find will last for a few hours.

**What is the radial velocity exoplanet detection method?**
An exoplanet detection method that utilizes the slight movement of a star, known as the "wobble effect," that occurs in response to the gravitational tug of an orbiting planet. These movements produce shifts in the star's spectrum and tell us about the mass of an orbiting planet. Some of the planets that TESS finds will be observed by ground-based telescopes using precise instruments to measure radial velocity.

**What are the main mission objectives for TESS?**

- Monitor over 200,000 of the brightest dwarf stars for transiting exoplanets
- Use ground-based telescopes to measure the masses of 50 planets smaller than Neptune

**How many Earth-sized planets is TESS expected to find?**
Astronomers predict that TESS will discover more than 50 Earth-sized planets and up to 500 planets less than twice the size of Earth.

**How many total planets is TESS expected to find?**
In addition to Earth-sized planets, TESS is expected to find some 20,000 exoplanets in its two-year prime mission. Planets less than twice the size of Earth will primarily come from the two-minute postage stamp data, while larger planets will mostly be found in the full-frame images. TESS will find upwards of 17,000 planets larger than Neptune.

**What can TESS learn about the planets it discovers?**
From the transit data alone, scientists will be able to determine the sizes of planets with respect to their parent stars and their orbital parameters. Ground-based follow-up observations of these objects, possible because of the brightness of the host stars, will allow astronomers to determine the masses of these planets. Combining the two measurements will allow astronomers to determine the density of these worlds, and hence their bulk composition (Giant planets? Water worlds? Rocky, like Earth?). In addition, transit observations can be used to study the dynamics of planetary systems, such as planet-planet interactions.

**How will TESS build upon the findings from Kepler/K2?**

Kepler used a "pencil-beam" survey, looking deep over a single patch of sky and K2 looked at a small number of fields totaling about 4 percent of the sky. While this type of survey was ideal for Kepler's mission, most of the planets found by Kepler were orbiting comparatively faint stars not ideally suited to sensitive follow-up measurements. TESS will cover a sky area 20 times larger than those surveyed by Kepler and K2, finding planets around bright, nearby stars that are well-suited to follow-up observation and characterization with both ground-based facilities and space telescopes like Hubble, Spitzer and Webb.

**How much closer to Earth are the planets TESS will find compared to Kepler?**

About 10 times closer. Typical distances to planets that TESS will find are 30 to 300 light-years, whereas most planets that Kepler found are 300 to 3,000 light-years away.

**What do we know about exoplanets so far?**

Using a wide variety of methods, astronomers have discovered more than 3,700 exoplanets to date, largely through transit and radial velocity surveys. Because of Kepler/K2, we know that our galaxy likely hosts more planets than stars, including perhaps more than 10 billion potentially habitable worlds.

**Will TESS be able to detect planet atmospheres and biosignatures?**

No. TESS is a survey mission and will identify the presence of exoplanets. After scientists identify the best TESS candidates suitable for atmospheric follow-up, large telescopes like Webb and ground-based observatories can probe their atmospheres, to learn more about their structures and compositions, and look for spectral signatures that may indicate the planet could harbor life.

**How will TESS work with existing and future missions?**

Additional follow-up will allow measurement of the atmospheric composition and structure of some planets. This will open the door for a host of new discoveries about exoplanets, and perhaps shed light on the processes behind the formation and evolution of planetary systems.

**What science will come out of the TESS Guest Investigator program?**

The TESS Guest Investigator Program allows the worldwide scientific community to compete for research funding and observations of some 40,000 targets. NASA will support scientists in both the analysis of these data and in studies that take advantage of the full-frame images. The Guest Investigator program is expected to answer compelling questions in almost every area of astrophysics and planetary science, including exoplanet characterization, stellar astrophysics, galactic and extragalactic astrophysics and solar system science. All data will be public.

# TESS Q&A: Data and Launch

**What is the lifetime of the TESS mission?**

The prime science mission is a two-year all-sky survey. After this, the team will be invited to propose an extended mission, which, if successful, could continue the TESS mission as long as it is scientifically compelling and capable.

**What are the instruments aboard TESS?**

The TESS payload consists of four identical wide-field-of-view cameras, all mounted onto a single plate. Each of the four cameras has:

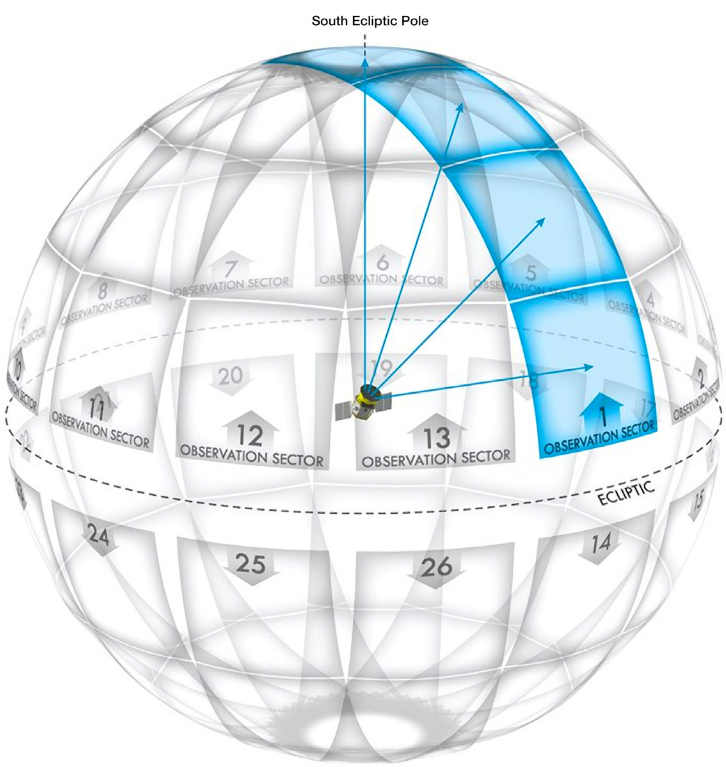
- 24-by-24-degree field of view
- 100 mm effective pupil diameter
- Lens assembly with 7 optical elements
- Athermal design
- 600 nm–1000 nm bandpass
- one 16.8-megapixel, low-noise, low-power MIT Lincoln Lab CCID-80 detector consisting of four CCDs

**Who created the TESS cameras?**

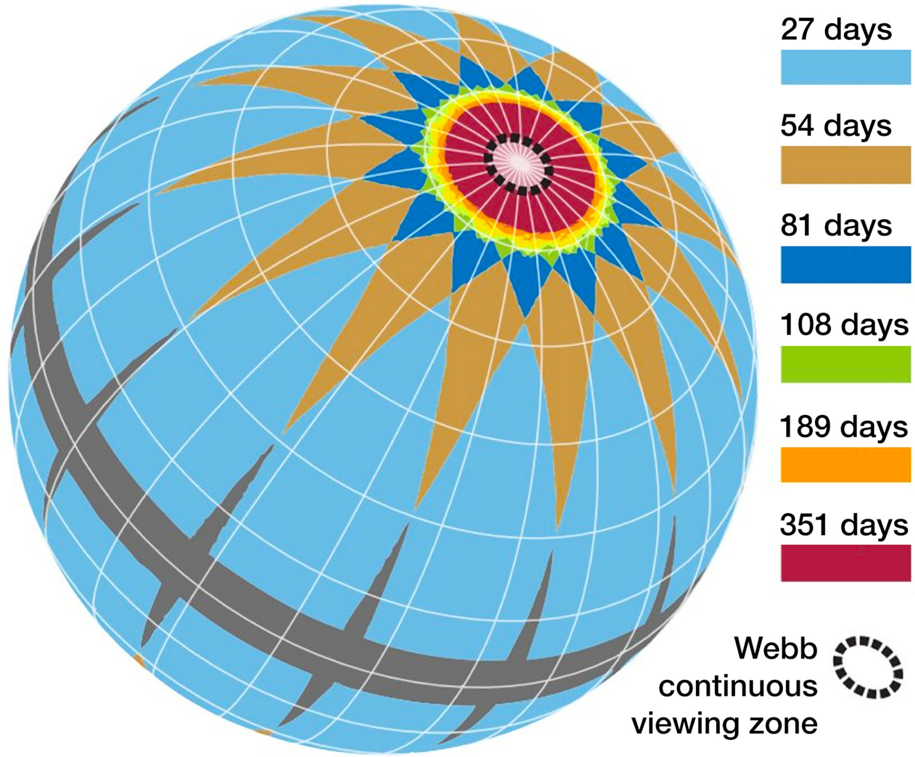
The TESS cameras were developed by the MIT Kavli Institute for Astrophysics and Space Research and MIT's Lincoln Laboratory.

**How will TESS collect its data?**

TESS will spend its first year mapping the southern sky and its second year mapping the northern sky. Using its four cameras, TESS will tile the sky with 26 observation




*TESS divides the sky into 26 observation sectors (13 per celestial hemisphere) each spanning 24 by 96 degrees. TESS will spend its first year surveying the southern sky, then begin the northern survey.* MIT




*This map illustrates how TESS will cover the sky over its two-year mission. Observation sectors overlap at the ecliptic poles, which are points perpendicular to the plane of Earth's orbit, and provide improved sensitivity there. TESS coverage is maximized within 12 degrees of the ecliptic poles, areas that include zones where the James Webb Space Telescope will be able to observe targets throughout the year.* MIT

sectors, staring for at least 27 days at each 24-by-96-degree sector. It will observe the brightest 200,000 dwarf stars at a two-minute cadence and produce full-frame images with a 30-minute cadence. TESS observation sectors will overlap at the ecliptic poles for improved sensitivity to shorter- and longer-period planets. Areas within five degrees of the ecliptic poles are located within the James Webb Space Telescope's continuous viewing zone, where Webb will be able to view targets throughout the year.

**Where will mission operations be?**

The Mission Operations Center (MOC) is located at and operated by Orbital ATK in Dulles, Virginia. The MOC interfaces with the Deep Space Network (DSN) and the Space Network to communicate with the TESS observatory for command and telemetry. The MOC also works with the Flight Dynamics Facility at NASA Goddard to generate position and tracking data.

**How will TESS data be collected and processed?**

The Payload Operations Center (POC) at MIT will coordinate with the MOC at Orbital ATK to schedule all science observations and conduct instrument planning. The POC will also interface with the DSN to receive the science data and begin processing. The POC will then send processed data to the Science Processing and Operations Center (SPOC) at NASA's Ames Research Center, which will calibrate the data and produce light curve files to detect exoplanet transit signatures. These products will then be sent

*Technicians at Orbital ATK in Dulles, Virginia, examine the fully integrated TESS spacecraft in November 2017.* Orbital ATK

to MIT, which will send them to the Mikulski Archive for Space Telescopes (MAST) and the TESS Science Office (TSO), which further reviews the data and identifies TESS objects of interest to be used for follow-up observations.

**How will the data be distributed?**
The STScI's Mikulski Archive for Space Telescopes (MAST) will archive all TESS mission data and make it publicly available.

**What type of orbit will TESS use?**
TESS will orbit Earth using a stable 2:1 resonance with the Moon's orbit. This is a thermally stable, low-radiation orbit that will ensure an unobstructed view for continuous light curves. TESS will undergo two 13.7 day orbits per observation sector.

**What type of spacecraft is TESS?**
TESS is based on Orbital ATK's LEOStar-2 platform, a flexible, high-performance spacecraft for space and Earth science, remote sensing and other applications. LEOStar-2 can accommodate various instrument interfaces and support payloads up to 1,100 pounds (500 kilograms). Performance options include redundancy, propulsion capability, high-data-rate communications, and high-agility, high-accuracy pointing. TESS will be the eighth spacecraft based on LEOStar-2 built for NASA. Previous missions include SORCE, GALEX, AIM, NuSTAR and OCO-2.

**When is the TESS launch?**
TESS has a launch readiness date of March 2018 and is expected to launch no earlier than April 16, 2018.

**Where will TESS launch from?**
Cape Canaveral Air Force Station at NASA's Kennedy Space Center.

**What type of rocket will TESS launch on?**
A SpaceX Falcon 9 launch vehicle.

**Who can help with features, interviews, multimedia, and other resources?**
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**felicia.chou@nasa.gov**

# TESS Q&A: Partners

**Who are the partners involved with TESS?**

- MIT's Kavli Institute for Astrophysics and Space Research (MKI) and MIT's Lincoln Laboratory led the development of the TESS mission and built its four wide-field cameras. MIT is the principal investigator's institution.
- MKI jointly leads the TESS Science Office with the Harvard-Smithsonian Center for Astrophysics and leads analysis of mission data.
- MKI is responsible for operating the payload during flight and for the Science Operations Center located at MIT.
- NASA Goddard manages the mission, including systems engineering, safety and mission assurance, and communications. It is also responsible for the TESS Guest Investigator Program.
- Orbital ATK provides the spacecraft bus and is responsible for the Mission Operations Center.
- NASA's Ames Research Center provides the science data processing pipeline.
- STScI administers the mission's science archives.
- The Harvard-Smithsonian Center for Astrophysics is a partner with MIT in the TESS Science Office.

**Who is the TESS Principal Investigator?**
Dr. George Ricker at MIT's Kavli Institute for Astrophysics and Space Research.

**Who provided the TESS spacecraft and integration/testing?**
The TESS spacecraft was developed, integrated, and tested at Orbital ATK in Dulles, Virginia.


*Technicians mount the TESS cameras onto the camera plate in August 2017, prior to installation on the spacecraft.* Orbital ATK

**Who is responsible for the science data-processing pipeline?**
NASA's Ames Research Center leads the development and operation of the scientific data pipeline; MIT leads associated data validation efforts.

# Acronyms and Abbreviations

**CCD** Charge-Coupled Device
A charge-coupled device is a device for the movement of electrical charge, usually from within the device to an area where the charge can be manipulated, for example conversion into a digital value. This is achieved by "shifting" the signals between stages within the device one at a time.

**CfA** Harvard-Smithsonian Center for Astrophysics
CfA is one of the largest and most diverse astrophysical institutions in the world, where scientists carry out a broad program of research in astronomy, astrophysics, earth and space sciences, and science education.

**DSN** Deep Space Network
The Deep Space Network supports NASA and non-NASA missions that explore the furthest points of our solar system. The DSN has three ground stations located approximately 120 degrees apart on Earth (120 + 120 + 120 = 360).

**HEO** High Earth Orbit
A geocentric orbit with an altitude entirely above that of a geosynchronous orbit.

**MIT** Massachusetts Institute of Technology
The Massachusetts Institute of Technology is a private research university in Cambridge, Massachusetts, known traditionally for research and education in the physical sciences and engineering, and more recently in biology, economics, linguistics, and management as well.

**MKI** MIT Kavli Institute for Astrophysics and Space Research
The mission of the institute is to facilitate and carry out the research programs of faculty and research staff whose interests lie in the broadly defined area of astrophysics and space research.

**NASA** National Aeronautics and Space Administration
NASA is the agency of the United States government that is responsible for the nation's civilian space program and for aeronautics and aerospace research.

**STScI** Space Telescope Science Institute
STScI is the science operations center for the Hubble and Webb space telescopes.

**TESS** Transiting Exoplanet Survey Satellite
TESS is a planned space telescope for NASA's Explorer program, designed to search for extrasolar planets using the transit method.

# Glossary

**Astronomical unit (AU)**
A unit of measurement for distances in space. This unit is based on the distance from the Earth to the Sun, which is equal to 1 AU. 1 AU = 92,955,807 miles (149,597,871 kilometers).

**Biosignature**
An indicator that provides scientific evidence of past or present life, usually in the form of an element or molecule.

**Candidate exoplanet**
A signal in the data that exhibits the characteristics of a transiting exoplanet but has not yet been confirmed.

**Confirmed exoplanet**
A signal in the data that exhibits the characteristics of a transiting exoplanet and has been confirmed, typically with additional data from complementary surveys or statistical analyses of existing data.

**Dwarf star**
A star that burns hydrogen and is between 10 and 100 percent the size of the Sun. This contrasts with giant stars such as red giants which can be hundreds of times larger than the Sun.

**Exoplanet**
A planet found orbiting a star outside our solar system. In some cases, more than one exoplanet is discovered orbiting the same star, making it part of a multiple planetary system.

**Field of view**
The region of the sky that is seen in through a telescope at any given moment.

**Habitable zone**
The region around a star within which a planet could sustain liquid water on its surface given a suitable atmosphere (neither too close/hot nor too far/cold).

**Hot Jupiter**
Exoplanets that are roughly the same mass as Jupiter (or larger), but which orbit extremely close to their star.

**Hubble Space Telescope**
NASA's Hubble Space Telescope was carried into orbit by space shuttle Discovery on STS-31 in April 1990. Hubble is one of NASA's Great Observatories and was the only telescope ever designed to be serviced in space by astronauts. The Space Telescope Science Institute, located on the Johns Hopkins University Homewood campus in

Baltimore, Maryland, is the science operations center for both Hubble and the James Webb Space Telescope.

**James Webb Space Telescope**
The Webb telescope is a 6.5-meter space telescope scheduled to be launched in 2020. Webb is optimized to study infrared light from the Universe with four sensitive imaging and spectroscopic instruments.

**Light-year**
The distance that light can travel in a vacuum in one Earth year (equivalent to approximately 6 trillion miles).

**Orbital period**
The time it takes an object to complete a full orbit of another object.

**Radial velocity**
An indirect exoplanet detection method that utilizes the slight movement of a star, known as the "wobble effect," that occurs in response to the gravitational tug of a planet orbiting that star. These movements affect the star's light spectrum, or color signature, enabling detection with this method.

**Stellar class**
The classification system used to rank stars by their spectra and temperature. Stars are ranked in order of decreasing temperature by: O, B, A, F, G, K and M.

**Spectrum**
A graph of an object's emitted light, sorted by color, similar to the way sunlight is spread out into colors in a rainbow.

**Spectroscopy**
A method of studying an exoplanet's spectra to determine that planet's properties, such as chemical components in its atmosphere.

**Transit**
The passage of an exoplanet in front of its parent star as viewed from the observer's perspective, which results in a drop in the amount of light normally emitted by a star.

**Transit photometry**
A method to detect exoplanets by measuring the change in brightness of a star as an orbiting planet passes in front of that star.

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