Jet Propulsion Laboratory
California Institute of Technology

π IN THE SKY 4

You don't have to be a NASA rocket scientist to discover potentially habitable worlds outside our solar system. All you need is a little pi!

Discover more "π in the sky" math problems at:
jpl.nasa.gov/edu/nasapidaychallenge

HABITABLE HUNT

Scientists can learn a lot about planets beyond our solar system by studying their stars. They can calculate an exoplanet's orbital period by measuring how often its star dims as the planet passes by. They can even find potentially habitable worlds with a few key details. The star's temperature and luminosity, which are related to its mass, define its habitable zone, the area where liquid water can exist. And the bond albedo, or percentage of light reflected by the exoplanet, helps estimate its temperature. Scientists recently discovered seven Earth-like planets orbiting the star TRAPPIST-1. **Given TRAPPIST-1's measurements, what are the inner and outer radii (r), in AU, of its habitable zone?** Use the formula below.

$$r = \sqrt{\frac{(1-A)L_*}{16\pi\sigma T^4}}$$

Given the orbital periods (T_p), for TRAPPIST-1's planets, which are in the habitable zone? Use Kepler's third law to find the semi-major axis of each planet's orbit (a_p).

$$a_p^3 = \mu_{cb}\left(\frac{T_p}{2\pi}\right)^2$$

LEARN MORE ABOUT EXOPLANETS
exoplanets.nasa.gov

TRAPPIST-1 SYSTEM
L_* (star luminosity) **= 2.0097x10^{23} watts**
μ_{cb} (star gravitational parameter) **= 1.06198x10^{19} m^3/s^2**
σ (Stefan-Boltzmann constant) **= 5.67×10^{-8} Wm^{-2}K^{-4}**
T (planetary temperature) **= 192-295 K**
A (planetary bond albedo) **= 0.3**

TRAPPIST-1b T_p = 1.51087081 days
TRAPPIST-1c T_p = 2.4218233 days
TRAPPIST-1d T_p = 4.049610 days
TRAPPIST-1e T_p = 6.099615 days
TRAPPIST-1f T_p = 9.206690 days
TRAPPIST-1g T_p = 12.35294 days
TRAPPIST-1h T_p = 20 days