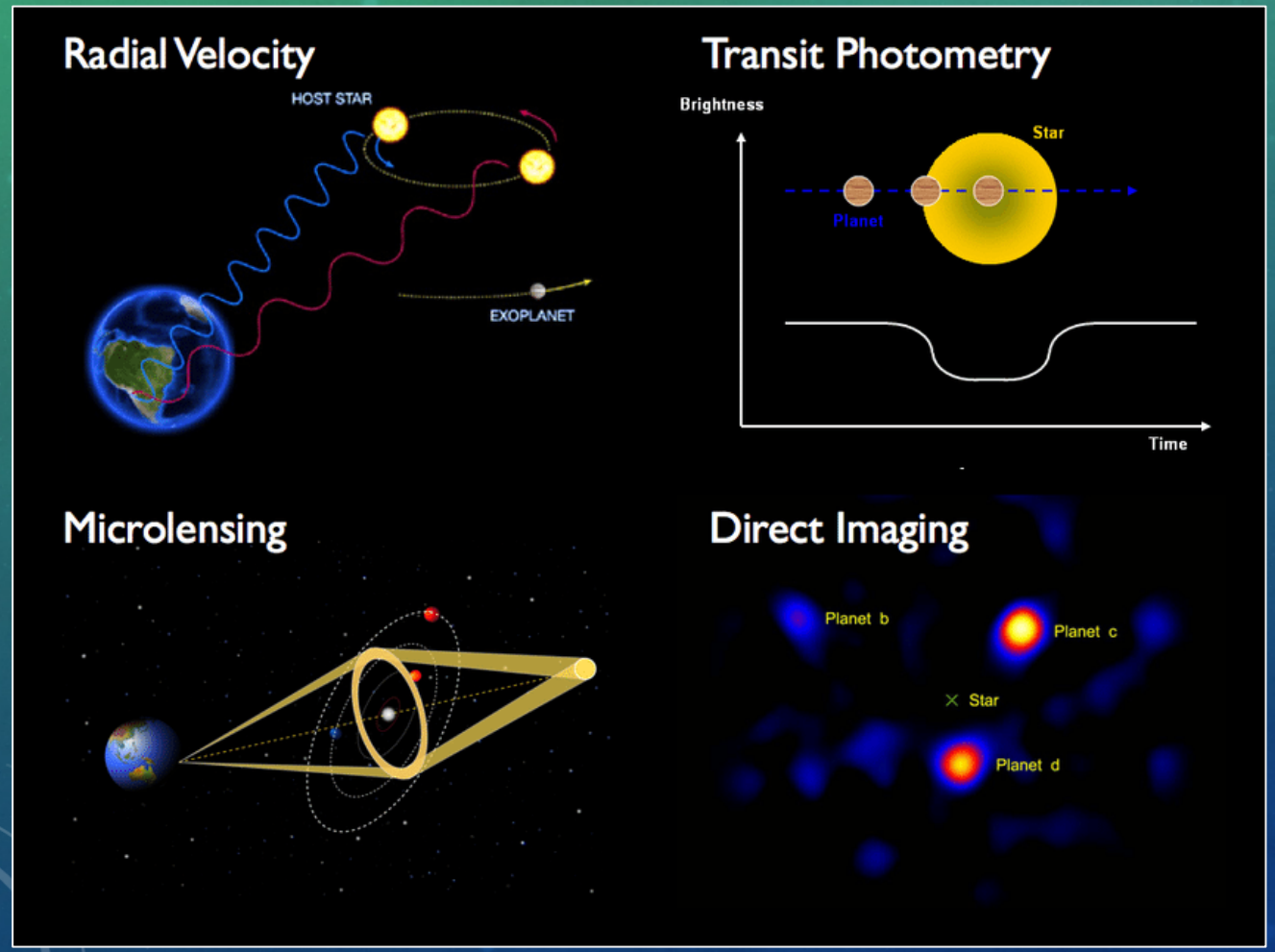
EXTRASOLAR PLANETS: DETECTION AND HABITABILITY

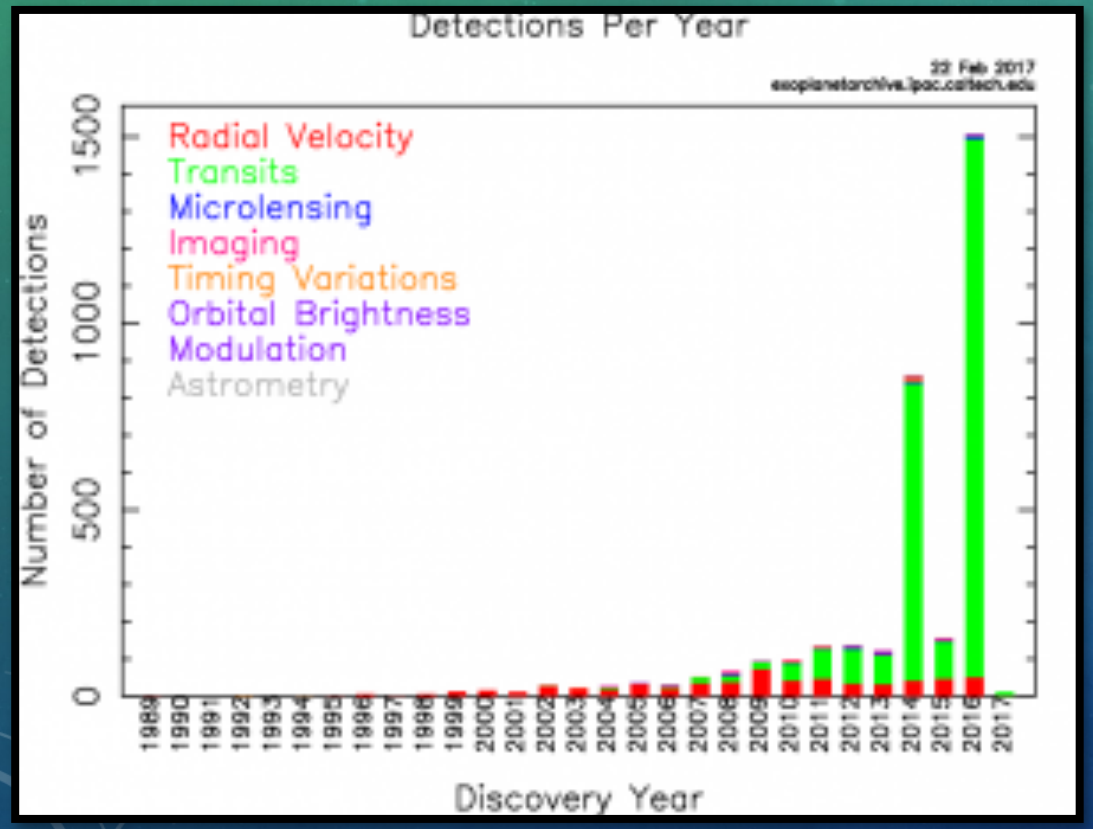
LAB DUE THURSDAY, OCT. 31ST, BY 5 PM.

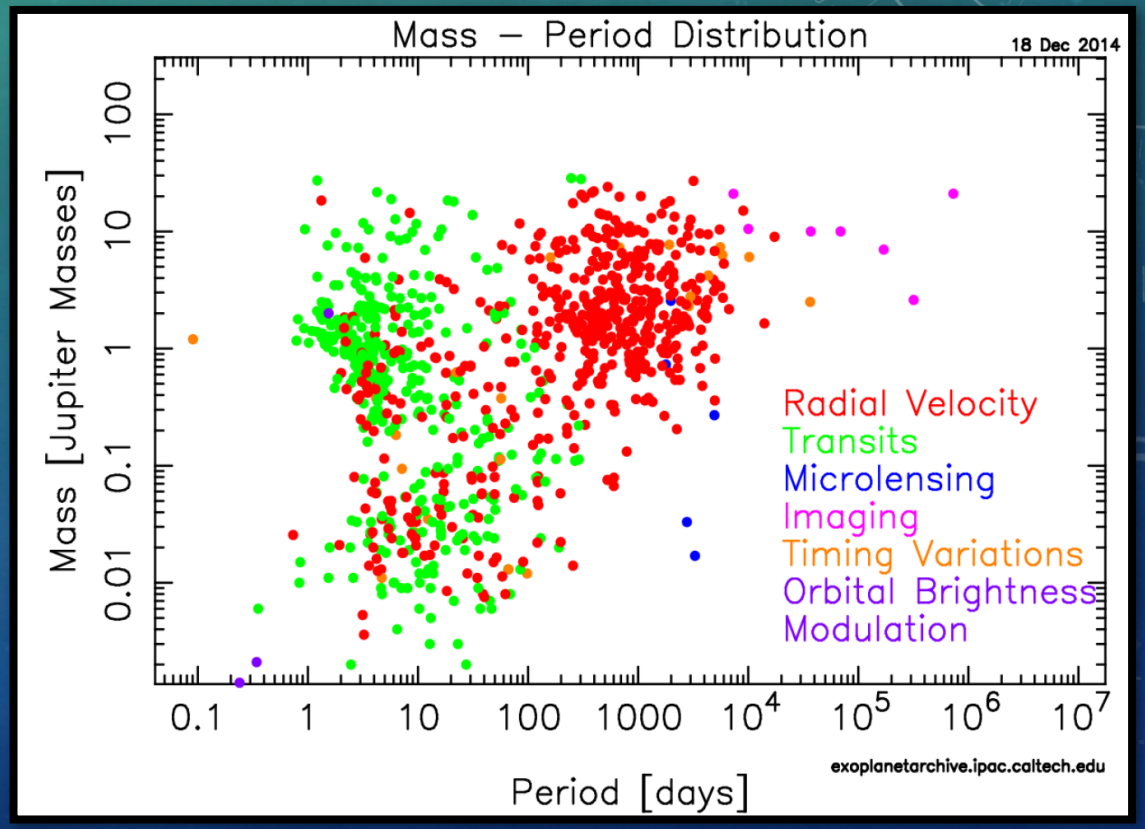
EXOPLANET DETECTION: 4 MAIN WAYS



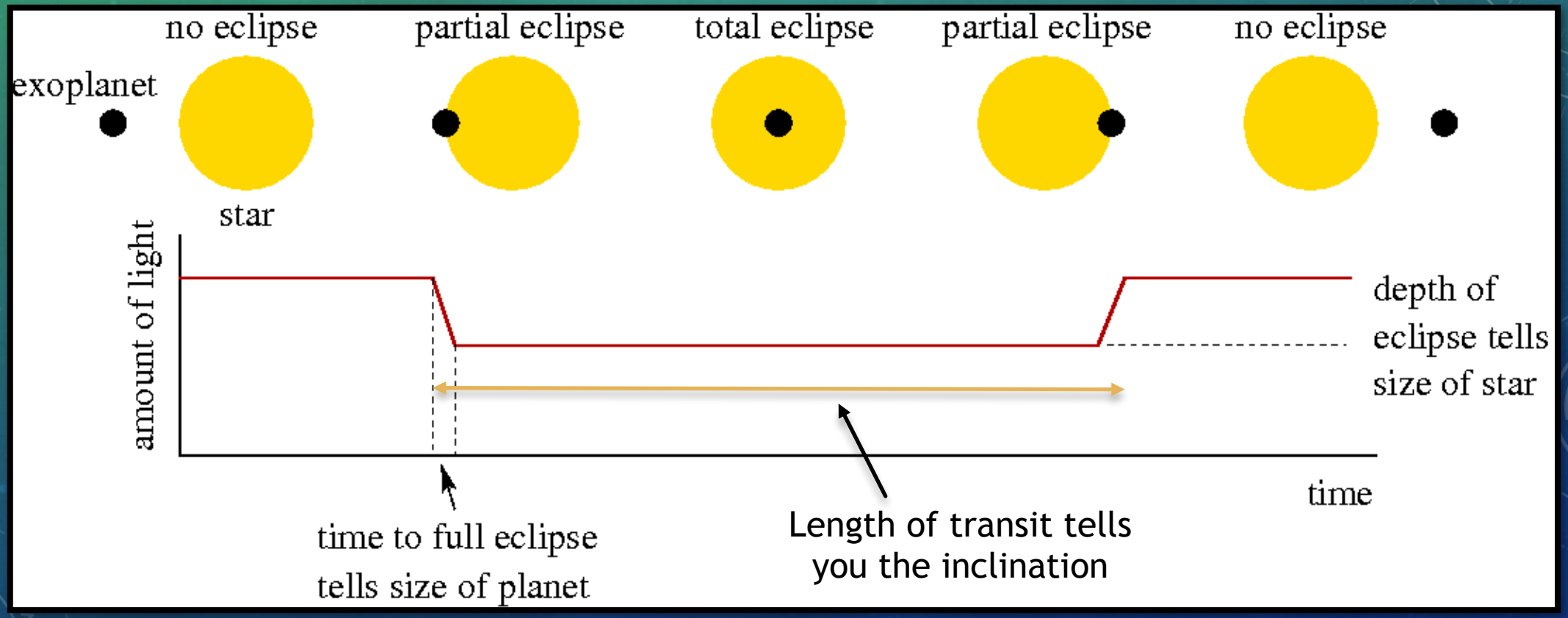
For more info, check out this cool page on the NASA website: https://exoplanets.nasa.gov/5-ways-to-find-a-planet/

WHAT METHOD HAS FOUND THE MOST CANDIDATES?

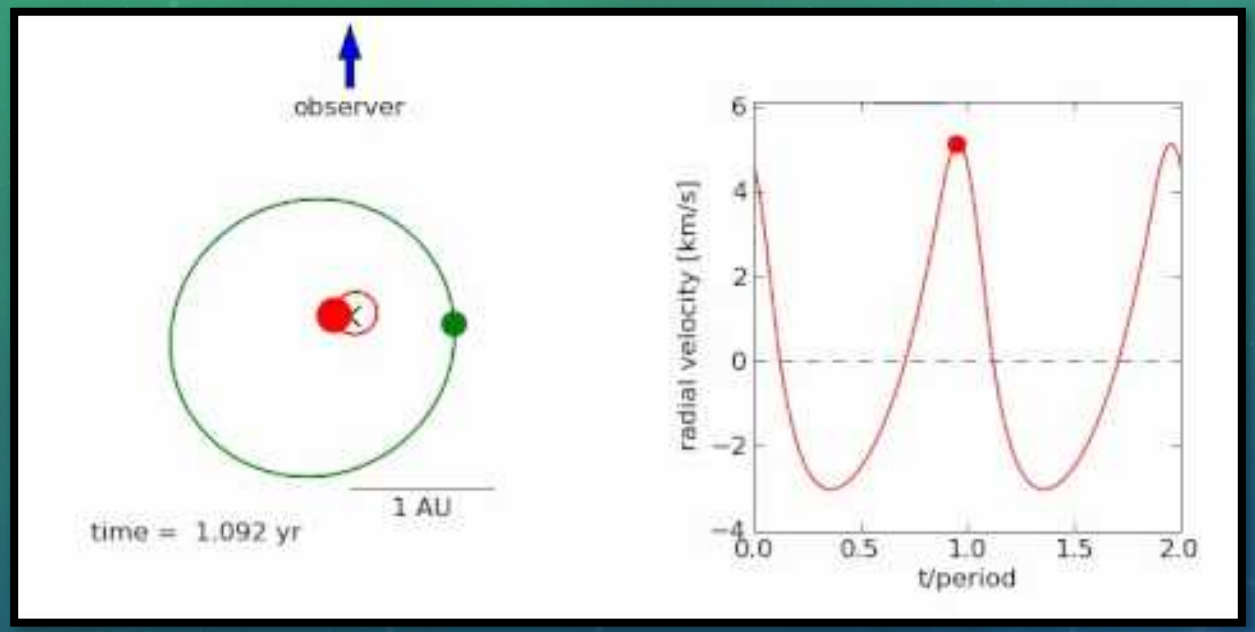


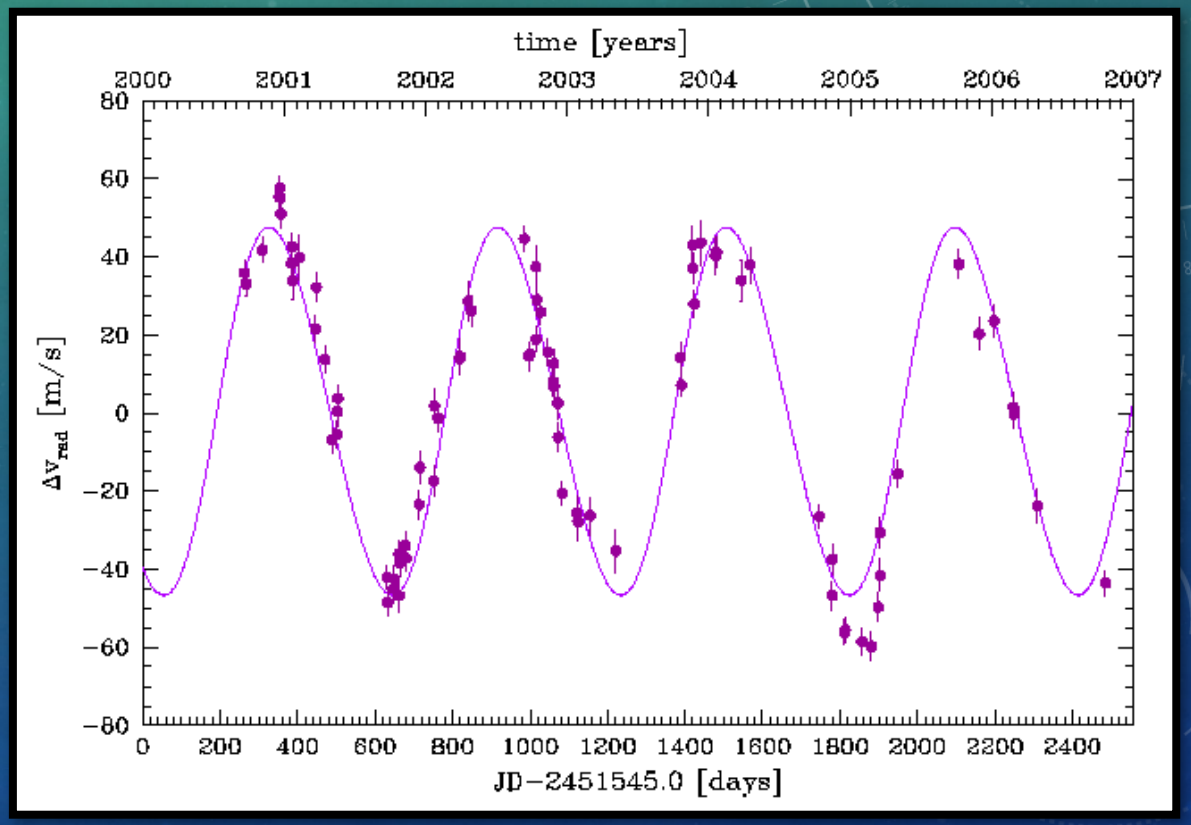


TRANSITS CAN TELL US A LOT ABOUT THE PROPERTIES OF EXOPLANETS



RADIAL VELOCITY CURVES ALSO TELLS YOU CERTAIN PROPERTIES



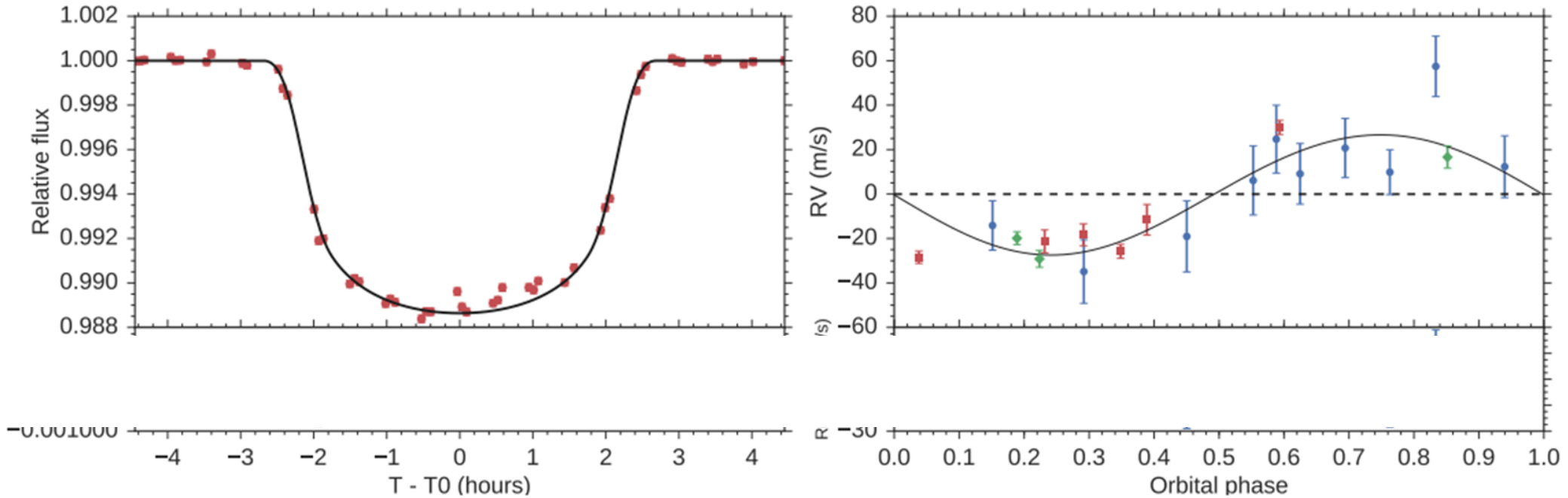


- Mass is related to velocity: The heavier the planet, the higher its velocity and vice versa.
- The x-axis, in time, shows us the period of the planet.
- Remember! . If the period changes, so does the semi-major axis.

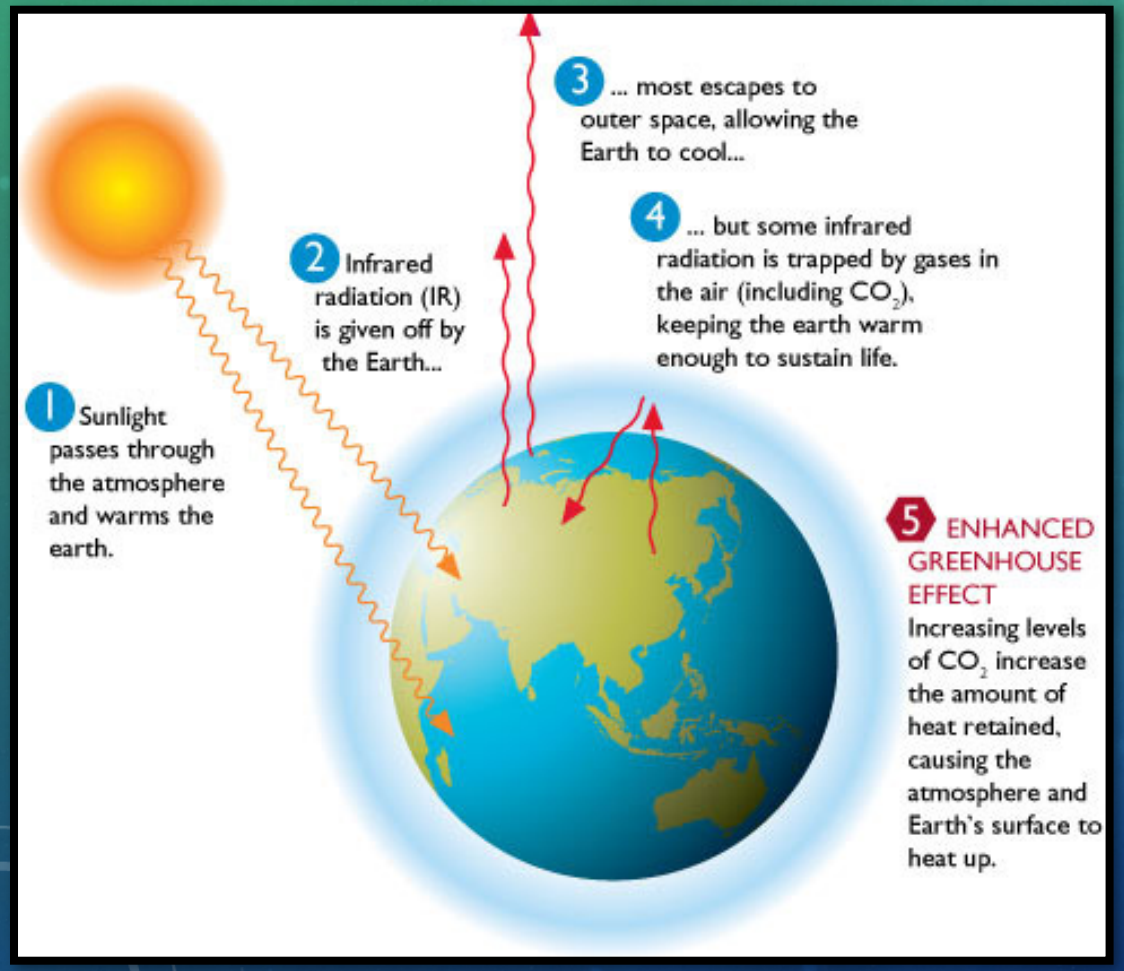
HD209458 B

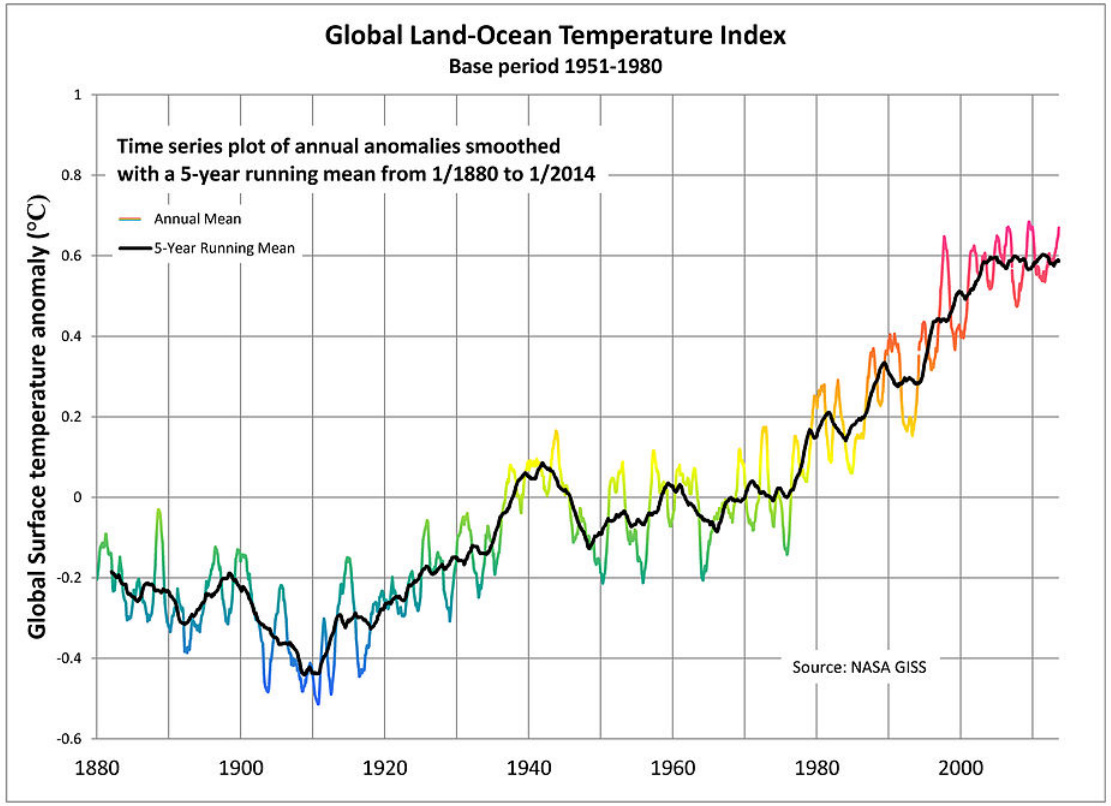
Use the program Planet to find the properties of HD209458 B.
You will first use the transit to find the:
1. Radius
2. Inclination

Next, you will use its velocity curve to find the:
3. Mass
4. Period (Hint, it's already given in the book)
5. Semi-major axis


Relative flux
1.002
1.000
0.998
0.996
0.994
0.992
0.990
0.988
−4
−3
−2
−1
0
1
2
3
4
T - T0 (hours)
RV (m/s)
80
60
40
20
0
−20
−40
−60
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Orbital phase

GREENHOUSE EFFECT AND GLOBAL WARMING



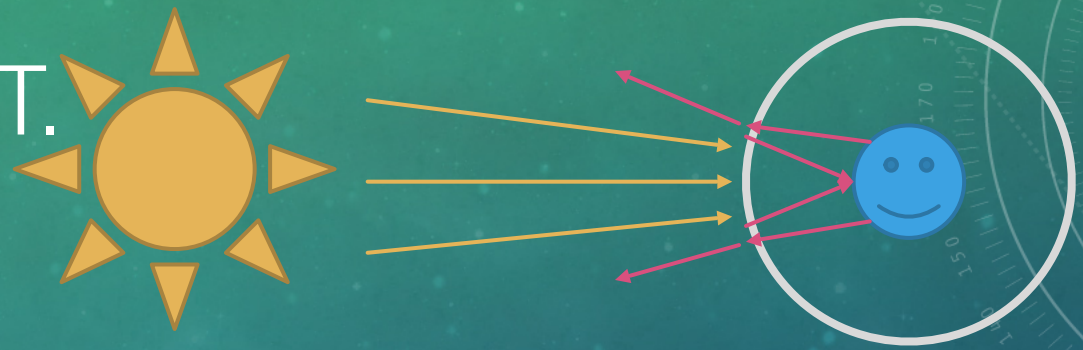


CALCULATIONS

Lets see what the temperature of Venus, Earth and Mars would be without an atmosphere :

- First and foremost, energy conservation!
- This means that the energy from the sun, must be re-radiated by the planet surfaces. It does this in the form of infrared radiation (heat).
- , Where L is the solar luminosity, r is the radius of the planet, D is the distance between the sun and planet, and F is the fraction of light absorbed (1-albedo).
- , where r again is the radius, T is the planet temperature, and B is the Stefan-Boltzmann constant.
- Equating the two equations give , where .

CALCULATIONS CONT.



Next, lets see what the temperature would be with an atmosphere!

- Atmospheres let visible light through but absorbs the infrared radiation.
- Because the suns light is mostly in the visible spectrum, remains unchanged.
- However, some of the infrared light radiated from the planets surface is absorbed by the atmosphere and re-radiated back to the surface, leaving the planet with some extra heat!
- Note that still holds true, so energy re-radiated by atmosphere must equal .
- Half is radiated back out to space, and half is radiated back the planet surface, aka .
- Solving this gives us, .
- Therefore, . More heat!

MOLECULES MATTER

- Some molecules are better at absorbing infrared radiation than others.
- Therefore, the types of molecules in the atmosphere are important.
- CO2 is one of these molecules (We will see this first hand!).
- The CO2 cycle keeps Earth's climate warm and stable.
- However, like most things, too much is not good!