

# AST 120 Activity 7

## The Planets

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Name	Full	Partial	None

We have already examined the motion of two of the things that move through the sky in an odd way: the Sun and the Moon. Now we will take a look at the other five: Mercury, Venus, Mars, Jupiter, and Saturn.

1. Go to a computer and launch Stellarium. Make sure you are in Rome, GA.
2. Stop the flow of time (7) and set time to now (8).
3. Turn off the atmosphere (a), fog (f), and ground (g).
4. Turn on the equatorial grid (e), the ecliptic (,), and the equator (.).
5. Open the Search window (magnifying glass on left) and type in Venus. Hit return. This should center Venus in your view and label it for you. Track (t) Venus.
6. Advance time by days (either sidereal or solar) to see how Venus moves against the stars. The easiest way to do this is to hold down the Add 2 Solar Day (=) key. Watch the motion of Venus for a while. Remember that we are watching how Venus moves *relative to the background stars*. Don't forget that Venus, along with the background stars and everything else up there, participates in the daily rotation about the Celestial Sphere.
7. Most of the time Venus moves \_\_\_\_\_.
  - (a) Westward, staying close to the Ecliptic
  - (b) Eastward, staying close to the Ecliptic (like the Sun and Moon)
  - (c) along a path that does not stay close to the Ecliptic
8. Make sure you watch Venus' motion until it does something unusual. In what important way is the motion of Venus different from that of the Sun and Moon?

9. When Venus moves Westward relative to the fixed stars it is said to exhibit *retrograde* motion. When Venus is in the middle of its retrograde motion it is in \_\_\_\_\_.
- (a) Eastern quadrature ( $90^\circ$  east of the Sun)
  - (b) conjunction (in the same part of the sky as the Sun)
  - (c) Western quadrature ( $90^\circ$  west of the Sun)
  - (d) opposition (in the opposite part of the sky from the Sun)
10. The time between consecutive retrograde motions is called the planet's *synodic period*. Since Venus is always in conjunction during the middle of its retrograde we can measure the synodic period by finding the time between these conjunctions. But we have to be careful because Venus also has conjunctions in which it is moving eastward (prograde) relative to the stars. Find a date on which Venus has a retrograde conjunction and record it below. Then find the date for the next retrograde conjunction and record that below. Then determine the approximate synodic period of Venus (to the nearest month).
11. Does the path of Venus repeat? In particular, when Venus undergoes a retrograde loop does this loop look the same each time? You may want to watch Venus do a few more loops to see.
12. The time it takes for a planet to go completely around the sky (i.e. all the way around the Celestial Sphere) is known as its *zodiacal period* (because the planets move through the constellations of the Zodiac). Determine the approximate zodiacal period of Venus by finding the difference between a date when it crosses the Celestial Meridian ( $RA=0^h$ ) and the next date it crosses that line. Record your result below.
13. Now remeasure the zodiacal period for Venus' next pass around the Celestial Sphere. Is your result the same as for your previous measurement?

14. Although the synodic period of a planet is (at least approximately) constant, the zodiacal period may vary significantly from one cycle to the next because of the planet's retrograde motion. Because of this problem, we define the zodiacal period as the *average* time for the planet to go all the way around the Celestial Sphere, where the average is taken over many cycles. Determine the average zodiacal period for Venus by starting on February 3, 2001 (when Venus is at RA=0 hours) and measuring how long it takes Venus to complete ten cycles around the Celestial Sphere. Divide this time by ten to get the average zodiacal period.
15. Throughout Venus' motion relative to the stars, does it ever get very far away from the Sun?
16. Now go back to Search window and find Mercury. Track Mercury and advance time by days. Watch the motion of Mercury for a while. Does Mercury also exhibit retrograde motion?
17. Does Mercury stay close to the Sun like Venus? The angular distance between the Sun and a planet is known as the planet's *elongation*. Is Mercury's maximum elongation less than, greater than, or equal to that of Venus?
18. Determine the approximate synodic period (time between retrograde conjunctions) of Mercury. Record your answer in the space below.
19. Determine the approximate zodiacal period (time to go around the Celestial Sphere) of Mercury, averaged over ten cycles. Record your answer in the space below.
20. Now find Mars and watch its motion for a while. Does Mars exhibit retrograde motion?

21. Does Mars stay close to the Sun? What is the maximum elongation of Mars?
22. When Mars undergoes retrograde motion it is in \_\_\_\_\_.  
(a) Eastern quadrature  
(b) conjunction  
(c) Western quadrature  
(d) opposition
23. Determine the approximate synodic period of Mars and write your result below. Note that Mars does not have retrograde conjunctions like Venus and Mercury. It only has prograde conjunctions. But the time between these conjunctions still gives the synodic period.
24. Determine the approximate zodiacal period of Mars (averaged over ten cycles) and write your result below.
25. Watch the motion of Mars again and this time pay close attention to how the brightness of Mars changes. When is Mars the brightest?
26. Now find Jupiter and watch its motion. Does Jupiter exhibit retrograde motion?
27. Does Jupiter stay close to the Sun?
28. Determine the approximate synodic period of Jupiter and write your result below.

29. Determine the approximate zodiacal period of Jupiter (averaged over ten cycles) and write your result below. For this measurement you may want to speed up the simulation (for example, you could advance time by solar weeks using the ] key).
30. Now find Saturn and watch its motion. Does Saturn exhibit retrograde motion?
31. Does Saturn stay close to the Sun?
32. Determine the approximate synodic period of Saturn and write your result below.
33. Determine the approximate zodiacal period of Saturn (averaged over ten cycles) and write your result below.