

Orbit Maker: Activity 1

Getting Started in Low Earth Orbit

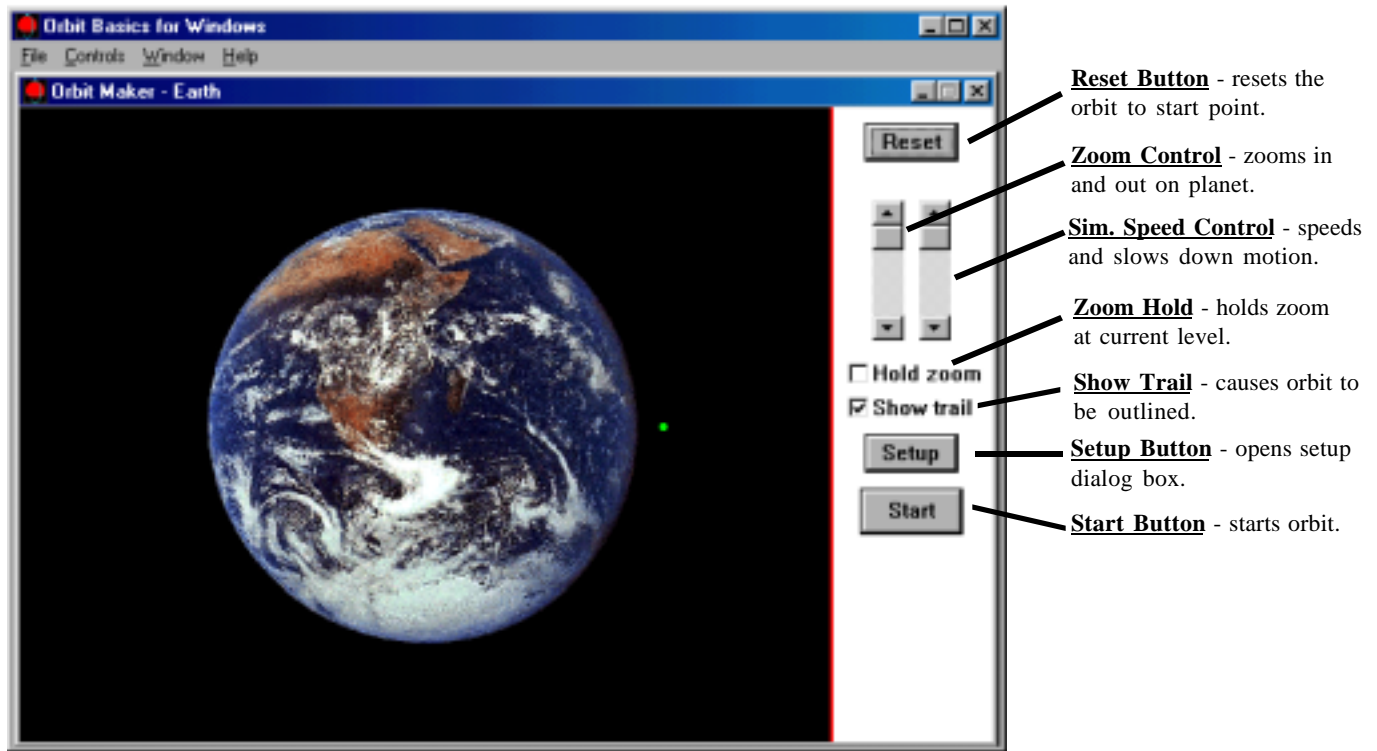


Fig. 1 Orbit Maker main window.

Getting Started...

Go to the **File** menu and select **Orbit Maker**. The window shown in Fig. 1 will appear. With Orbit Maker you can design different orbits. When Orbit Maker opens the Earth is shown along with a green satellite. The satellite is in a circular low earth orbit (LEO). Click on the **Start** button to start the orbit. Click anywhere in the window to stop the orbit.

Using the Controls...

Try the using the following controls:

1. Click on the **Reset** button to move the satellite back to its starting position. Click the **Start** button to restart the orbit.
2. Click on the **Show trail** check box and then restart the orbit. The satellite leaves a trail showing the orbit.
3. Move the **Zoom Control** (see Fig. 1) up and down to zoom in and out on the scene. Zoom out on the scene and restart the orbit.
4. Click on the **Hold zoom** check box to hold the zoom at its current level. This will be a helpful feature in the next activities.
5. Slide the **Sim. Speed Control** (see Fig. 1) down and restart the orbit. The speed of the orbit will be reduced.

Spend some time experimenting with the controls. You can use these controls in the coming activities to customize your view the orbits you create.

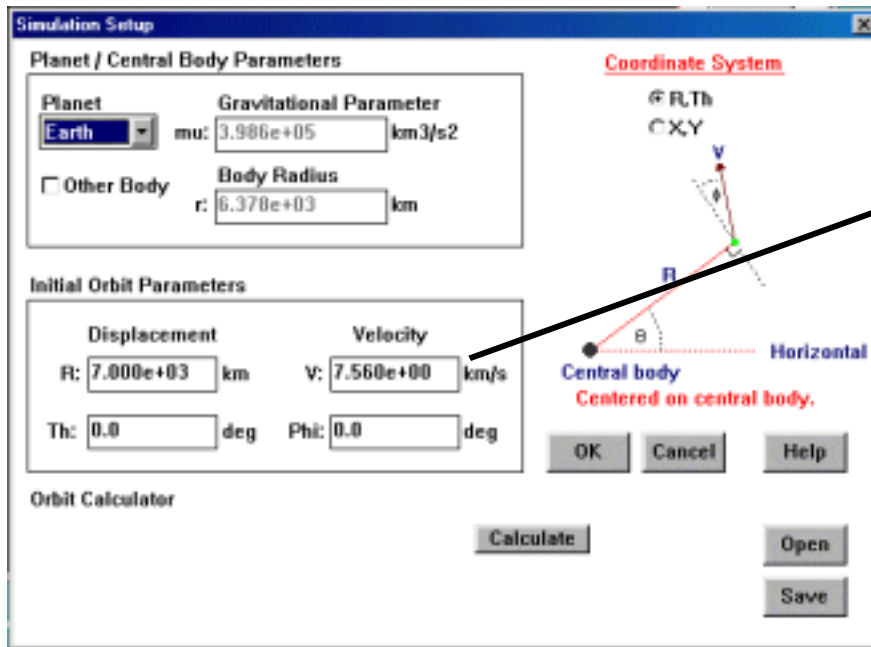
Low Earth Orbit Million Dollar Question (ask your TA for the prize money)

Which of the following does *not* orbit the Earth in LEO?

- A) Space Shuttle
- B) Russian space station Mir
- C) Geosynchronous satellites
- D) Hubble Space Telescope

Orbit Maker: Activity 2

To Infinity and Beyond



Velocity Edit Box - used to change the initial velocity of the satellite.

Fig. 2 Simulation Setup dialog box.

The Next Step...

Now that you mastered LEO, try next modifying the orbit. Click on the **Setup** button in the Orbit Maker main window to open the Simulation Setup dialog box. The window shown in Fig. 2 will appear. The parameters are set for the circular low Earth orbit you have been using. In the **Velocity** edit box, the initial velocity of the satellite is set at 7.560 km/s. This is the velocity the satellite has at the beginning of its orbit. Increase the velocity slightly to 8.00 km/s. Click on the **OK** button to close the dialog box and return to the main window. Start the orbit. How has the orbit changed?

Escape to Infinity...

Try the following.

1. Using the Simulation Setup dialog box, slowly increase the initial velocity in small increments. What is happens to the eccentricity of the orbit? As the initial velocity of the satellite increases, what happens to the energy of the satellite?
2. At higher velocities, eventually the satellite will have enough energy to escape the gravity of Earth and keep going forever to infinity. At what initial velocity does the satellite escape the gravitational pull of Earth?
3. What will happen if you reduce the initial velocity of the satellite below 7.560 km/s? Try it and find out.

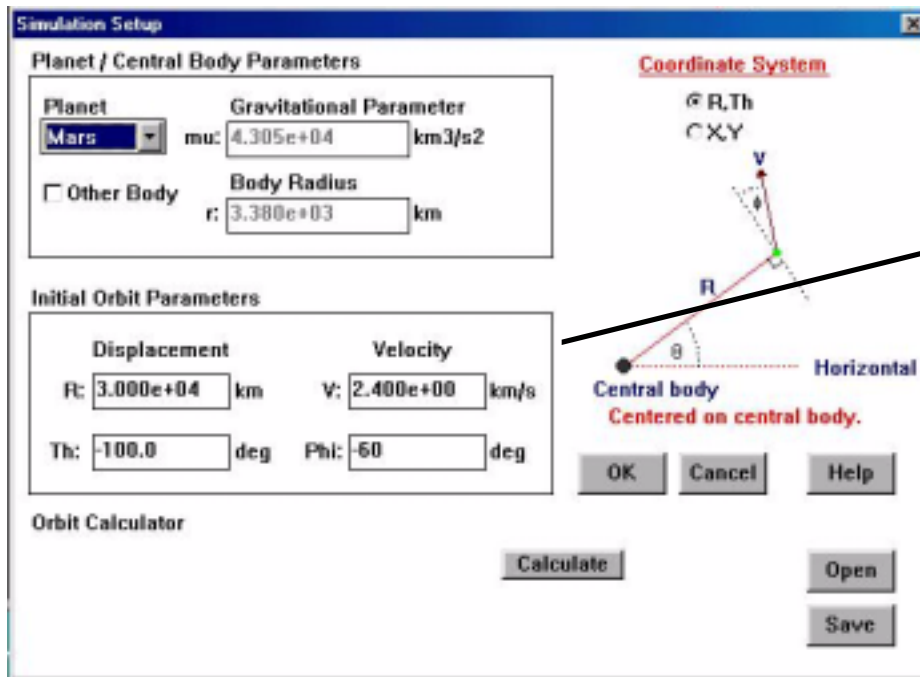
Elliptic Orbit Million Dollar Question

The point closest to the Earth in a satellite's orbit is called

- | | |
|---------------|-------------|
| A) Perigee | B) Apogee |
| B) Perihelion | C) Aphelion |

Orbit Maker: Activity 3

Mars Flyby: Don't Get Too Close



Initial Orbit Parameters
Set these parameters to the values shown to set up a Mars flyby orbit.

Fig. 3 Mars flyby setup.

The NASA Challenge...

NASA recently lost the Mars Climate Orbiter spacecraft when it flew too close to Mars and burned up in the Martian atmosphere. Can you do better than NASA? Click on the **Setup** button to open the Simulation Setup dialog box. Select **Mars** in the **Planet** drop-down menu. Enter the following values for a Mars flyby orbit in the Initial Orbit Parameters:

<u>Edit Box</u>	<u>Value</u>
R:	3.000e+04
Th:	-100.0
V:	2.400e+00
Phi:	-60

Click **OK** and return to the Orbit Maker main window. Simulate the flyby by clicking on the **Start** button. What type of orbit is the flyby?

See how well you can navigate in space. Vary the initial velocity **V** and flight path angle **Phi** to see how close you can flyby Mars without crashing. The more negative you make **Phi**, the closer your orbit will come to Mars.

Tour the Solar System...

Now that you have the hang of Orbit Maker, experiment with orbits around other planets.

Mars Million Dollar Question

What was the name of the spacecraft that recently disappeared while attempting a landing on Mars?

- A) Mars Climate Lander
- B) Mars Climate Orbiter
- C) Mars Polar Crasher
- D) Mars Polar Lander