Venus
<table>
<thead>
<tr>
<th>Venus - Vital Statistics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Distance from Sun</td>
<td>0.723 AU (1.082 x 10 km)</td>
</tr>
<tr>
<td>Mean Orbital Speed</td>
<td>35.0 km/sec</td>
</tr>
<tr>
<td>Sidereal Period</td>
<td>224.70 days</td>
</tr>
<tr>
<td>Rotation Period</td>
<td>243.01 days (retrograde)</td>
</tr>
<tr>
<td>Inclination of Axis</td>
<td>178 degrees</td>
</tr>
<tr>
<td>Inclination of Orbit</td>
<td>3 degrees, 23 minutes</td>
</tr>
<tr>
<td>Mass</td>
<td>0.815 M$_E$ (4.87 x 10$^{24}$ kg)</td>
</tr>
<tr>
<td>Mean Density</td>
<td>5.25 g/cm$^3$</td>
</tr>
<tr>
<td>Albedo</td>
<td>0.76</td>
</tr>
</tbody>
</table>
Similarities to Earth

About the same size, mass and density

Different in hospitality
Surface temperature 750 K
Surface pressure 90 atmospheres
Atmosphere primarily carbon dioxide
Extremely thick cloud cover
Temperature and Pressure

1 bar is atmospheric pressure
Differences from Earth

Rotation

Rotates clockwise about its own axis - Retrograde rotation

Time to rotate about own axis is longer than it takes to go around the Sun

The effective solar day is 116.8 days

Magnetic field

No magnetic field
Greenhouse Effect

Two type of Greenhouse Effects

Normal
Natural activity of all terrestrial planets with atmospheres

Enhanced
Natural greenhouse gases are added to
Normal Greenhouse Effect

Sunlight enters upper atmosphere
\(\gamma\)-rays, X-rays, UV blocker by particular molecules such as ozone
Incoming IR blocked by greenhouse gases such as \(\text{CO}_2\), \(\text{H}_2\text{O}\) and \(\text{CH}_4\)
Remaining sunlight enters lower atmosphere and strikes surface – primarily visible and radio wavelengths
Rocks and air warmed by this radiation
Energy reradiated in the infrared
Infrared blocked from escaping by the greenhouse gases causing temperatures to rise
Normal Greenhouse Effect

The Greenhouse Effect

- Solar radiation passes through the clear atmosphere.
  - Solar radiation: 183 Watt per m²

- Incoming solar radiation is reflected by the atmosphere and earth's surface.
  - Outgoing solar radiation: 103 Watt per m²

- Some of the infrared radiation is absorbed and re-emitted by the greenhouse gas molecules. The direct effect is the warming of the earth's surface and the troposphere.

- Some of the infrared radiation passes through the atmosphere and is lost in space.
  - Net outgoing infrared radiation: 210 Watt per m²

- Solar energy is absorbed by the earth's surface and warms it...
  - 183 Watt per m²

- ...and is converted into heat causing the emission of longwave (infrared) radiation back to the atmosphere.

Sources: Okanagan university college in Canada; Department of geography, University of Oxford, school of geography; United States Environmental Protection Agency (EPA) Washington; Climate change 1985, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge university press. 1996.
Venusian Atmosphere

Thickness - ~200km high
Composition:
  Carbon dioxide - 96%.
  Nitrogen – 3.5%
  Water Vapor – 0.01%
  Traces of
    Oxygen, Argon, and Neon
Sulfur in the form of S0₂ and H₂SO₄
Hydrogen sulfide condenses and falls like rain
Sulfuric Cloud Layer

Image taken in ultraviolet wavelengths
(Pioneer Venus 1979)
Venusian Clouds

The clouds on Venus are confined to a band between 50 km and 100 km.

These clouds are divided into three distinct layers, with each successively lower layer being denser and more opaque.

The clouds contain suspended sulfuric acid droplets.

The sulfuric acid droplets interact, and produce $\text{HSO}_3\text{F}$ - flurosulfuric acid.

The Venusian atmosphere also rotates in retrograde motion, with a circulation time of 4 days, with strong east to west winds.
Venusian Surface

First detailed surface information came from Magellan which was launched in 1989 and arrived 15 months later.
Venusian Surface

Surface relatively young
    Resurfaced 300 to 500 million years ago
Vast plains covered by lava flows
Mountain or Highland regions
Two continent like features
    Ishtar Terra
        Maxwell Montes – Highest Peak on Venus
    Aphrodite Terra
        Extend halfway around the equator of Venus
Venusian Surface
Venusian Surface

Surface has the following features:

- Volcanoes
- Craters
- Arachnoids
- Coronae
Volcanic Features

Maat Mons – 5 km high
Volcanic Features

Lava plains
- 85% of planetary surface
- Elevation 1.5km below mean radius to 2km above mean radius

Extensive lava flows
- Lengths range from a few to hundreds of kilometers in length
- Originate from volcanoes, cracks in crust and depressions in surface
**Volcanic Features**

**Lava channels**
- Extend hundreds to thousands of kilometers
- Simple to branched channels

**Intermediate Volcanoes**
- 20 to 100 kilometers in diameter
- Usually symmetric shields with radial lava flows
- Pancake Volcanoes - thick eruptions from vents
Volcanic Features

Intermediate Volcanoes
Tick (flat concave summit)

Large Volcanoes
100 to 600 kilometers in diameter
Volcanic Features

Calderas
Circular to elongated depressions
Often show concentric patterns of fractures
Sacajawea Patera
(2 km depression)
**Craters**

Yablochkina Crater
Some Crater Generalities

Impact of meteorites
- Shallow material is deposited farthest from rim of crater
- Deepest material is deposited closest to crater rim

Craters
- Large - Might have several rings and smooth floors
- Intermediate – Tend to have central peak
- Small – Simple bowl floor

Symmetry of crater is dependent upon angle of impact of meteorite
Craters on Venus

Distribution of craters
  Random over surface of Venus
Craters seem pristine
Small numbers of small craters
  Small meteorites burned up in Venusian atmosphere
Craters on Venus were created after surface was resurfaced 300 – 500 million years ago
Craters on Venus

Addams crater
Extensive outflow
Extends 600 kilometers from the crater rim

Because of the high temperature and pressure on the Venusian surface, impacts produce more melt than on other planets.
Outflow deposits are very thin and their direction is controlled by the local topography.
Coronae on Venus

Large (typically several hundred kilometers across), crown-like, volcanic features

Formed when plumes of rising hot material in the mantle push the crust upwards into a dome shape

Then collapses in the centre as the molten lava cools and leaks out at the sides, leaving a crown-like structure

Aruru Corona
Arachnoids on Venus

Similar in form but generally smaller than coronae (circular volcanic structures surrounded by a set of ridges and grooves as well as radial lines)
Greetings from
VENUS
THE CLOUDY PLANET