Mercury and Venus
Learning Objectives

- Contrast the Earth, the Moon, Venus and Mercury. Do they differ in density (composition, core), atmosphere, surface age, size, geological activity, magnetic field?
- What are scarps? Is Mercury’s surface hotter than Venus’ surface? How did the Caloris Basin form, and how is this linked to Venus’ clockwise rotation?
- Why does Venus have a long sidereal day (rotation period)? Why does Mercury have a long solar day?
- What are the inferior planets and why do they appear close to the Sun in the sky as viewed from the Earth?
- What features tell us that Venus’ surface is particularly young but Mercury’s surface is particularly old?
The Terrestrial Planets

Distance Line for the Inner Solar System

- From center of Sun to its surface: 0.0047 AU
- From center of Sun to Mercury: 0.39 AU
- From center of Sun to Venus: 0.72 AU
- From center of Sun to Earth: 1.0 AU
- From center of Earth to center of Moon: 0.00026 AU
- From center of Sun to Mars: 1.5 AU

Mercury | Venus | Earth | Mars

0.0047 AU | 0.39 AU | 0.33 AU | 0.28 AU | 0.5 AU

Moon
Mercury Facts!

Unlike The Earth, Mercury has no moon of its own.

Mercury

Radius: 0.38 Earth
Surface gravity: 0.38 Earth
Mass: 0.055 Earth
Distance from Sun: 0.39 AU
Orbital Eccentricity: 0.21
Tilt: 0°
Year: 88 Earth days
Rotational Period: 59 Earth days
Solar day: 176 Earth days

The Moon

Radius: 0.38 Earth
Surface gravity: 0.38 Earth
Mass: 0.055 Earth
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Mercury’s Surface

- Mercury is similar to the Moon
- A heavily cratered surface
- No volcanoes
- An *exosphere* but no *atmosphere*
- But there are differences...
Mercury’s Surface in Hi-Res
Massive Crater

- Largest known crater is the Caloris Basin
  - 1550 km across
- Giant impact punctured the crust
  - Created rings of mountains
- Was once lava-filled
- Created “Weird Terrain” on opposite side of the planet
Weird Terrain

Seismic waves created odd, blocky terrain directly opposite Caloris Basin.
Scarps

- Mercury’s surface is “cracked”
- Huge cliffs called *scarps*
- Kilometers high
- Hundreds of kilometers long
- Formed when the planet cooled and shrank a few kilometers
Atmosphere? No... *Exosphere*

- Mercury has *no stable atmosphere*
  - It has a thin *exosphere* that is constantly created by the solar wind scouring rocks, but quickly escapes
- *Water ice* exists in Mercury’s polar crater shadows
- Lack of atmosphere and long solar days produces huge day/night temperature difference
  - 700K (430°C) to 100 K (-173°C)
The “Ironball”

- Mercury’s density is almost equal to the Earth’s.
- The surface is similar to the Earth and the Moon, this suggests a *large iron core*
  - About 80% of its radius (~50% of its volume)
  - Relatively, this would be the *largest* core of all the planets
- (A small part of) the core may still be molten
  - Mercury spins slowly and has a detectable but weak planet-wide magnetic field
Mercury’s Orbit

- Mercury is *tidally locked* to the Sun, like the Moon is to the Earth.
- Mercury rotates 3 times every 2 orbits.
- This makes a solar day on Mercury equal to 2 Mercurian years.
Mercury and Venus in our Sky

- Mercury and Venus are the *inferior planets*
- Mercury is never more than 28° from the Sun when viewed in our sky
- Venus is never more than 48° from the Sun
Venus Facts!

Unlike The Earth, Venus has no moon.
Soviet Landers on Venus

Color as seen on the surface of Venus

Venera 13

Color with atmospheric effects removed

USSR Academy of Sciences / Brown University
The Venusian Atmosphere

- Planet completely covered by clouds
  - Clouds are mostly sulfuric acid, but there’s also tiny amounts of water vapor
- Atmosphere mostly carbon dioxide (96%) and nitrogen (4%)
  - 90 times more air pressure than Earth
- Extremely hot
  - Surface temp - 750K
  - Greenhouse effect makes it hotter than Mercury
Impacts on Venus

- Venus has about 1,000 craters
- No trace of heavy bombardment
- Cratering rate indicates Venus’ surface is about 500 million yrs old
- Why?
  - Extreme temperatures soften rock, making the surface subject to major volcanic upheaval
  - The entire surface melts from time to time
Venus’ Interior

- Venus’ size and density are roughly equal to the Earth’s.
  - Indicates iron core of similar size to the Earth’s core.
- No internal magnetic field.
  - Very slow rotation: 243 Earth days.
Venus’ Strange Motion

- Doppler radar shows Venus rotates *backwards*
- Very slowly, once every 243 days
- Venus orbits once every 225 days (the Venutian year)
- There are about 2 Venus solar days per year
Next Time

The Red Planet