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# ASTRONOMY

**Chapter 8 EARTH AS A PLANET**
PowerPoint Image Slideshow


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## 8.1 THE GLOBAL PERSPECTIVE

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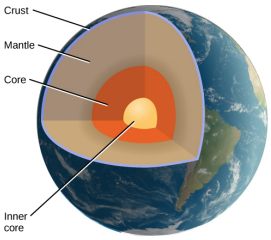
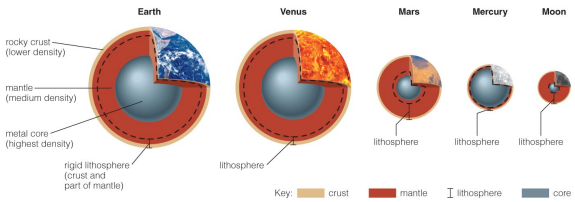
All our understanding of geological features are from observations and experiments here on Earth.

## Earth's Interior




- **Core:** Highest density; nickel and iron
  - Solid inner
  - Molten liquid outer
- **Mantle:** Moderate density; minerals with silicon, oxygen, etc.
- **Crust:** Lowest density; granite, basalt, etc.

## Terrestrial Planet Interiors



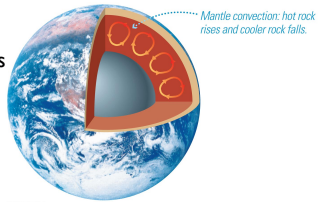

- Applying what we have learned about Earth's interior to other planets tells us what their interiors are probably like.



## Heat Drives Geological Activity

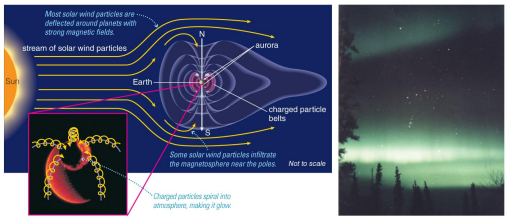
Convection: Hot rock rises, cool rock falls.

One convection cycle takes 100 million years on Earth.



## Magnetic Field and Magnetosphere

- Earth's magnetic field protects us from charged particles from the Sun.
- The charged particles can create aurorae ("Northern lights").






## Figure 8.5

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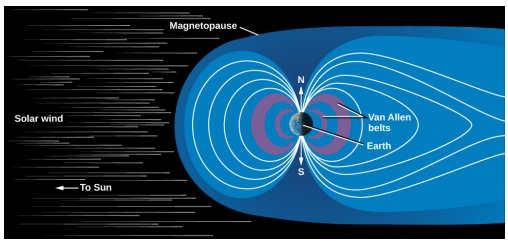


- **Earth's Magnetosphere.** A cross-sectional view of our magnetosphere (or zone of magnetic influence), as revealed by numerous spacecraft missions. Note how the wind of charged particles from the Sun "blows" the magnetic field outward like a wind sock.

## 8.2 EARTH'S CRUST

- How does the surface of Earth change?

- Impact cratering
  - Impacts by asteroids or comets
- Volcanism
  - Eruption of molten rock onto surface
- Tectonics
  - Disruption of a planet's surface by internal stresses
- Erosion
  - Surface changes made by wind, water, or ice



## Impact Craters

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- **Meteor Crater in Arizona.** Here we see a 50,000-year-old impact crater made by the collision of a 40-meter lump of iron with our planet. Although impact craters are common on less active bodies such as the Moon, this is one of the very few well-preserved craters on Earth. (modification of work by D. Roddy/USGS)

## Figure 8.22

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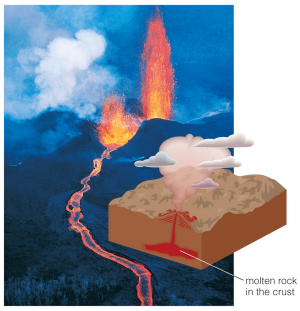
- **Site of the Chicxulub Crater.** This map shows the location of the impact crater created 65 million years ago on Mexico's Yucatán peninsula. The crater is now buried under more than 500 meters of sediment. (credit: modification of work by "Carport"/Wikimedia)

## Volcanism



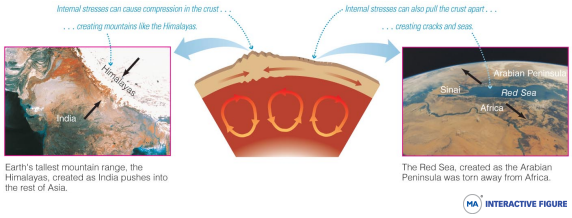

- Volcanism happens when molten rock (magma) finds a path through lithosphere to the surface.
- Molten rock is called *lava* after it reaches the surface.

## Outgassing

- Volcanism also releases gases from Earth's interior into the atmosphere.



## Tectonics




Earth's tallest mountain range, the Himalayas, created as India pushes into the rest of Asia.

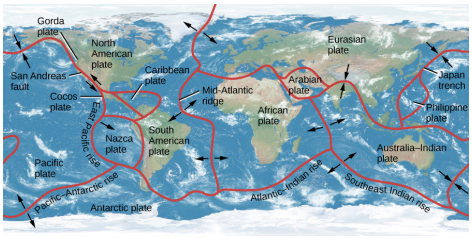
The Red Sea, created as the Arabian Peninsula was torn away from Africa.

INTERACTIVE FIGURE

- Convection of the mantle creates stresses in the crust called tectonic forces.
- Compression forces make mountain ranges.
- A valley can form where the crust is pulled apart.

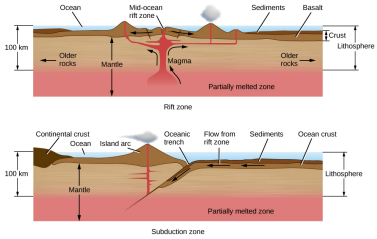


## Figure 8.7




- **Earth's Continental Plates.** This map shows the major plates into which the crust of Earth is divided. Arrows indicate the motion of the plates at average speeds of 4 to 5 centimeters per year, similar to the rate at which your hair grows.

## Figure 8.9




- **Rift Zone and Subduction Zone.** Rift and subduction zones are the regions (mostly beneath the oceans) where new crust is formed and old crust is destroyed as part of the cycle of plate tectonics.

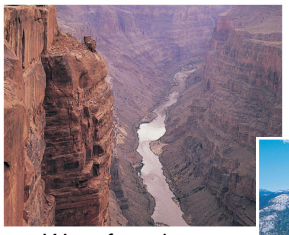
## Figure 8.10

- **San Andreas Fault.** We see part of a very active region in California where one crustal plate is sliding sideways with respect to the other. The fault is marked by the valley running up the right side of the photo. Major slippages along this fault can produce extremely destructive earthquakes. (credit: John Wiley)

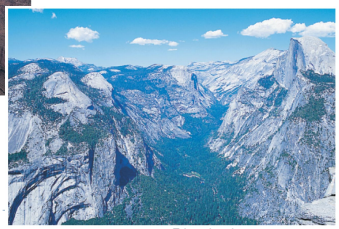
## Figure 8.11

- **Mountains on Earth.** The Torres del Paine are a young region of Earth's crust where sharp mountain peaks are being sculpted by glaciers. We owe the beauty of our young, steep mountains to the erosion by ice and water. (credit: David Morrison)

## Erosion



- Ice glaciers carved the Yosemite Valley.



- Watre from the Colorado River continues to carve the Grand Canyon.

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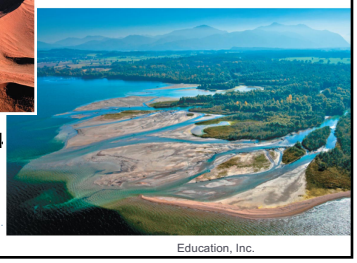
- Erosion can create new features by depositing debris.



- Wind wears away rocl and builds up sand dunes.

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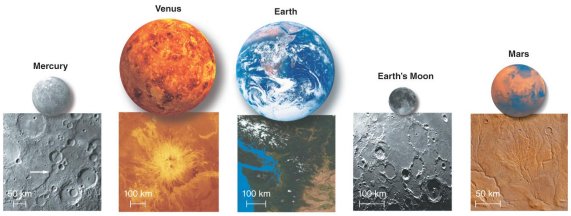
## We see similar features on other worlds

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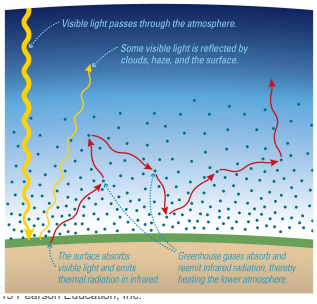
## 8.2 EARTH'S ATMOSPHERE

How does the atmosphere affect the planet?

1. Radiation protection
2. Greenhouse effect

Also makes the sky blue!

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## Figure 8.17

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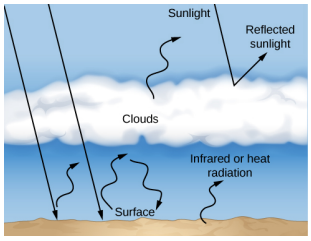


- **How the Greenhouse Effect Works.** Sunlight that penetrates to Earth's lower atmosphere and surface is reradiated as infrared or heat radiation, which is trapped by greenhouse gases such as water vapor, methane, and $CO_2$ in the atmosphere. The result is a higher surface temperature for our planet.

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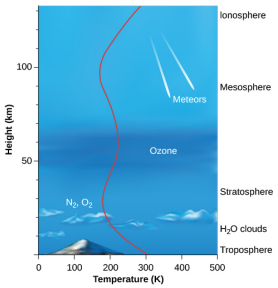
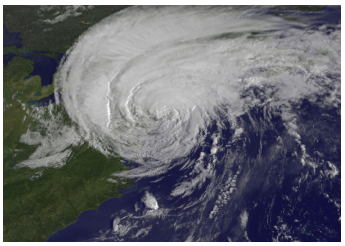
## Figure 8.12

- **Structure of Earth's Atmosphere.** Height increases up the left side of the diagram, and the names of the different atmospheric layers are shown at the right. In the upper ionosphere, ultraviolet radiation from the Sun can strip electrons from their atoms, leaving the atmosphere ionized. The curving red line shows the temperature (see the scale on the *x*-axis).

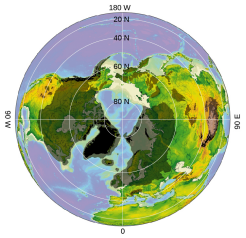


## Weather and Climate



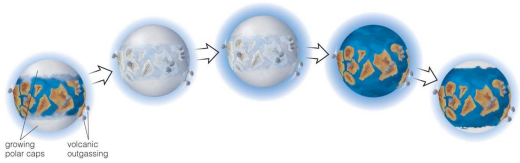
- **Storm from Space.** This satellite image shows Hurricane Irene in 2011, shortly before the storm hit land in New York City. The combination of Earth's tilted axis of rotation, moderately rapid rotation, and oceans of liquid water can lead to violent weather on our planet. (credit: NASA/NOAA GOES Project)

## Figure 8.14




- **Ice Age.** This computer-generated image shows the frozen areas of the Northern Hemisphere during past ice ages from the vantage point of looking down on the North Pole. The area in black indicates the most recent glaciation (coverage by glaciers), and the area in gray shows the maximum level of glaciation ever reached. (credit: modification of work by Hannes Grobe/AWI)

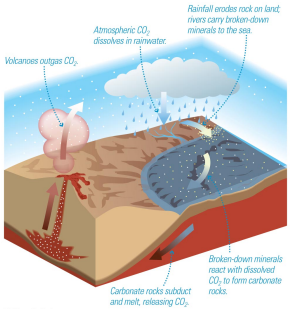
## Long-Term Climate Change




- Changes in Earth's axis tilt might lead to *ice ages*.
- Widespread ice tends to lower global temperatures by increasing Earth's reflectivity.
- $CO_2$ from outgassing will build up if oceans are frozen, ultimately raising global temperatures again.



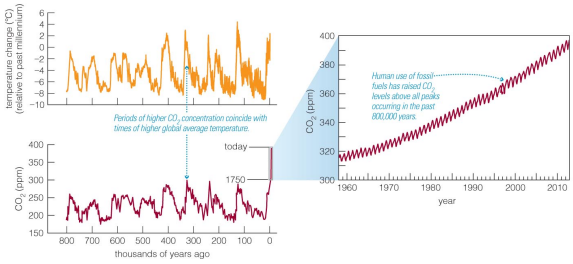
## Carbon Dioxide Cycle




1. Atmospheric $CO_2$ dissolves in rainwater.
2. Rain erodes minerals that flow into the ocean.
3. Minerals combine with carbon to make rocks on ocean floor.
4. Subduction carries carbonate rocks down into the mantle.
5. Rock melts in mantle and outgases $CO_2$ back into atmosphere through volcanoes.



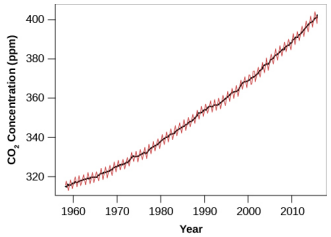
## $CO_2$ Concentration




- Most of the $CO_2$ increase has happened in the last 50 years!



## Figure 8.18




- **Increase of Atmospheric Carbon Dioxide over Time.** Scientists expect that the amount of $CO_2$ will double its preindustrial level before the end of the twenty-first century. Measurements of the isotopic signatures of this added $CO_2$ demonstrate that it is mostly coming from burning fossil fuels. (credit: modification of work by NOAA)

## Links

- VIEDO fly over earth 2 min

## Reading

- 8.1
- 8.2
- 8.3