Weathering of Rocks

• **Weathering** - Breakdown of rocks into pieces (sediment)

• 2 main types of weathering to rocks
  – *Mechanical weathering* requires physical forces to break rocks into smaller pieces.
  – *Chemical weathering* requires the transformation of rock into one or more new compounds.
Mechanical Weathering – Biological Activity

• plants & animals burrow through the rock
• Lichens
• Roots of plants

• humans
  – blast rocks apart looking for minerals
  – deforestation
Mechanical Weathering – Frost Wedging

- water forces its way into the cracks
- water freezes and expands
- rock splits apart
Chemical Weathering – Biological Activity

- dead organisms produce acids that dissolve the rock
Chemical Weathering – Water

- **Most important agent** of chemical weathering
- Oxygen reacts with the metals to produce oxide (rust)
- Acids dissolve away the surface of the rocks
Rate of Weathering

- **Climate**
  - Hot, wet climates (high humidity): high rates of weathering
  
  - Cold, arid (low humidity) climates & polar climates: low rate of weathering
Rate of Weathering

- **Amount of Exposed Rock**
  - More rock exposed, more weathering

- **Rock characteristics**
  - granite rocks are resistant to weathering (hard)
  - marble dissolves easily with acid rain (soft)
Soil

• 4 major components
  – Mineral matter – 45%
  – Organic matter (humus) – 5%
  – Water – 25%
  – Air – 25%

• Soil texture - type and amount of different sized particles found in the soil
  – texture determines how well the soil can grow crops
Soil Textures

There are 3 soil textures, which are all based on the SIZE OF THE PARTICLES!

**Sand** - Largest soil texture, feels gritty, you can see the grains (beach)

**Silt** - Medium size, feels slippery, looks like small flakes (some river sediments)

**Clay** - Very small, feels like dust, can’t see the individual particles because they are 1/20th the width of a hair (pottery is made of this)
Silt (medium, smaller than sand
So they fit closer together)

Sand (large, particles have lots of room between)

Clay (smallest, barely any space between each particle)
Soil Formation

• **Parent Material**
  – the rock that is below the soil is broken-down.

• **Time**
  – increase in time → increase in the amount of soil and thickness of the layer

• **Climate**
  – wetter, hotter climates will break-down parent material quicker
  – Drier, colder climates will take the longest
Soil Formation (cont’d)

- **Plants and burrowing animals**
  - create soil faster by leaving larger amounts of organic material

- **Slope** - steep slopes tend to have less soil
  - less water and less plants
  - mountain slopes that face the sun tend to have more soil
Soil Formation

**SOIL STRUCTURE**

O-horizon: leaf litter, organic material

A-horizon: plough zone, rich in organic matter

B-horizon: zone of accumulation

C-horizon: weathering soil; little organic material or life

R-horizon: unweathered parent material
The Rock Cycle

- **Rocks** are any solid mass of mineral or mineral-like matter that occurs naturally on Earth.
Types of Rocks

*** Classified by how they are formed***

• *Igneous* – cooling and solidification of lava

• *Sedimentary* – compaction and cementation of sediments

• *Metamorphic* – heat and pressure
The Rock Cycle

Thinking about relationships among the major rock groups...
Where does all the energy from this process come from?
The Rock Cycle (cont’d)

• The rock cycle does not always occur in a specific order.
  – Igneous rocks (Step 2) can directly become metamorphic rocks (Step 5).
**Igneous rocks**

Formed when molten rocks cools down and hardens

- Extrusive (ex means outside, forms outside the surface of earth)
- Intrusive (in for inside, cools inside the crust)

- Extrusive are Fine grained - cools rapidly
- Intrusive are Coarse grained - cools slowly
Metamorphic rocks

Formed when rocks are subjected to great quantities of heat and pressure below earth’s crust

- Banded or Foliated - heat and pressure squished into flat layers
- Non-Banded or Non-Foliated - heat and limited pressure, no layers from squishing


Sedimentary rocks

Formed when sediments dry up and form layers, baking in the heat of the sun.
- Clastic - sediments are cemented together (sandstone)
- Chemical - often times involves the evaporation of water from a solution (salt left behind in tide pool)
Erosion

- Movement of sediment by
  - Wind
  - Water
  - Ice
  - Humans
  - Animals
  - Gravity
Sediment size

- Larger pieces of sediment require more energy to move.
- Largest to Smallest:
  - Boulder
  - Cobble
  - Gravel
  - Sand
  - Silt
  - Clay
Deposition

- The settling of particles is known as *deposition*.
- Structures that form due to deposition
  - Deltas
  - Natural Levees
### Ideas Pertaining to Erosion

<table>
<thead>
<tr>
<th>Is Erosion happening faster today than in the past and why?</th>
<th>What affects the rates of erosion?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Climate, slope, vegetation</td>
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</tbody>
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What are some human activities that promote erosion?

- Deforestation, construction, old school farming
Longshore Current and Transport

- **Longshore Current** – the movement of water parallel to the shoreline.
Longshore Current and Transport

- *Longshore Transport* – the movement of *sand* along the beach.
Human Impacts

- **Seawall**—absorbs power of *incoming waves* and *tides* and halt the retreat of a shoreline
  - Parallel to seashore
  - Works to *save property* behind the wall
  - Causes the *sediments in front of the wall* to be swept in the ocean

Source: U.S. Army Corps of Engineers (1991)
Human Impacts

**Breakwater**
- A wall built **in the ocean** to reduce the size of waves
- **Parallel** to shore
- More useful for **protecting boats** than preventing erosion
Human Impacts

**Groins** – designed to **trap sediments** in an area of the beach

– **Perpendicular to shore**
– **Disrupts longshore transport**
– The beach on the other side of the groin will **continue to lose sediments**
Human Impacts

Beach Nourishment – adding sediment (from another beach, offshore bar, island or inland area) to increase the size of the beach

- Adding the wrong type can disrupt the natural processes
- The sediments may be contaminated with pollutants
Human Impacts

• **Plants and vegetation** – adding seagrass or another plant so that roots hold sand in place
Barrier Islands

North Carolina’s Outer Banks
What Are Barrier Islands?

• Long bodies of unconsolidated sand, separated from the mainland by a lagoon and from other islands by inlets at both ends.
North Carolina’s Outer Banks

- 90% of NC’s shoreline is made of barrier islands
- There are 18 North Carolina barrier islands
5 Components of a Barrier Island

• The Island, Inlets, Tidal Deltas, The Shoreface, The Beach
The Island

• Made up entirely of sand carried either from the ocean or from the lagoon beach by wind action and storm overwash

• A typical barrier island extends below sea level to a depth of 30 feet.
Inlets

• **Channels that separate** adjacent islands and allow the exchange of water between the ocean and lagoon

• Inlets **can open, close or migrate** in a matter of years.

• Inlets migrate when sand pours into them from longshore currents, forcing them to move downdrift.
Tidal Deltas

- Formed from sand deposited by the tidal currents
- Longshore currents bring sand from adjacent barrier islands into the mouth of the inlet
- Tidal currents move the sand to form the deltas
The Shoreface (the lower beach)

- From the shoreline to a water depth of 30-60 feet
- Contains the sand that may eventually form the beach and dunes
Formation of Barrier Islands

- Barrier islands are the product of sea level rise
  - **Step 1** - During Ice Age, sea levels were low due to so much water frozen in glaciers.
  - **Step 2** - As ice melts, sea level rises & river valleys are flooded.
  - **Step 3** - Formation of spit along headlands.
  - **Step 4** - Separation of barrier from mainland.