# Topic 12 – Shaping the Earth

## Vocabulary

**Abrasion** – physical action of scraping, rubbing, grinding or wearing away rock material

**Chemical weathering** – the process of using natural chemical reactions to break down rock

**Cut bank** – Outside bend in a stream where the water velocity is fastest and erosion is the greatest.

**Delta** – the region of a stream mouth where sediment is deposited as it flows into a large body of water in graded beds of largest to smallest particles

**Deposition** – the process where sediment is dropped out of the stream current and builds into layers

**Drumlin** – a glacial feature that is created as a glacier flows. The blunt end shows the direction of flow

**Erosion** – the removal of sediment and weather material from rock

**Glacier** – a mass of ice that flows due to gravity

**Kettle lake** – a small round lake that is formed when a large chunk of glacial ice creates a depression in the Earth's surface and melts

**Landscape** – regions on Earth's surface with similar surface feature such as mountains, plains and plateaus

**Mass movement** – the movement of large quantities of earth materials due to gravity, includes landslides, mudslides, rock slides and soil creep

**Meander** – the curve or bend of a stream channel

**Moraine** – a large ridge, pile or sheet of unsorted sediment deposited by a glacier

**Outwash plain** – a glacial feature of sorted layered sediment as the result of the glacier melting

**Physical weathering** – the mechanical breakdown of rock material at the earth's surface into smaller pieces

**Point bar** – Opposite the cut bank in a stream where the velocity is slowest and deposition is the greatest.

**Sand dune** – a sand feature where sediment is deposited by wind

**Sediment** – the particles that are formed from weathering and erosion

**Sorted sediment** – sediment is arranged into layers of similar size due to water depositing materials, water and wind sort particles

**Stream** – water flowing through a channel in land includes rivers and creeks

**Stream channel** – the body of rock or land that the stream flows within

**Stream discharge** – the volume of water that passes through a certain point in a stream in a specific amount of time, example gallons per minute, cubic meters per minute

**Stream drainage pattern** – the shape of the course a stream takes as viewed from above

**Tributary** – a small stream the feeds a larger stream

**U-shaped valley** – the shape of the valley after it has been eroded by a glacier

**Unsorted sediment** – deposited sediment is mixed sizes, glacial ice deposits unsorted sediment

**V-shaped valley** – the shape of the valley eroded after it has been eroded by water

**Watershed** – the area of land drained by water

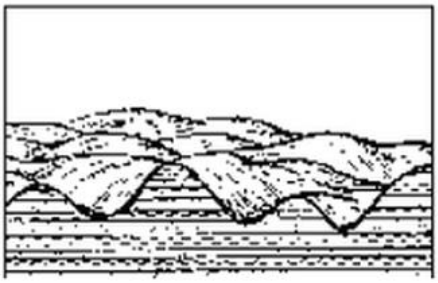
**Weathering** – the chemical and physical break down of rock material at or on the earth's surface

## Overview of Topic

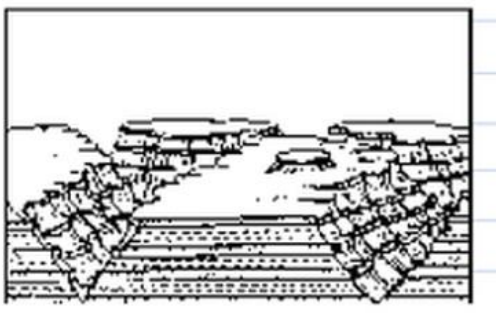
I. Landscape Characteristics

a. Landscape Regions
   I. Page 2 ESRT
      - New York State has several regions
      - Created as result of uplifting and leveling forces.
         i. Plate collisions create up lift
         ii. Water, wind and glaciers are leveling forces

b. Effects of climate on Landscapes
      - Climate
         i. Humid – moist
            - Streams create valleys and weather the bedrock.
            - Rain causes the landscape to be rounded.
            - Landscapes are rounded, rolling hills
            - Found primarily in New York State and the Eastern United States



         ii. Arid – dry
            b. Streams create valleys and weather the bedrock.
            c. Lack of rain causes landscape to be angular.
            - Landscapes are flat and angular
            - Found in desert regions of the United States



II. Weathering

I. 2 types

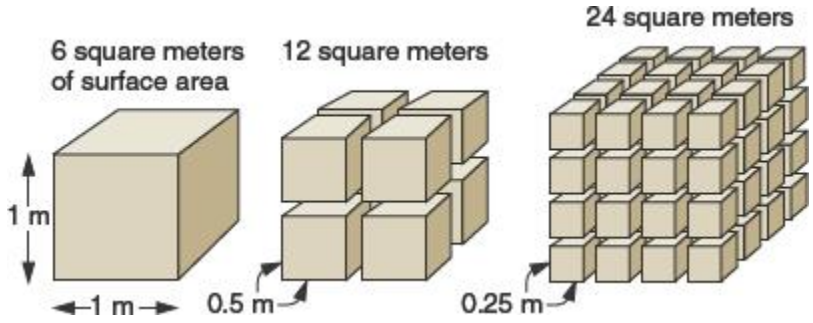
c. Chemical
   - Rock material breaks down as the result of interactions of chemicals.
   - Water is the biggest chemical weathering agent, interacts with minerals. Limestone is easily broken down by water, especially if it is acidic.
   - Oxidation is also known as rust happens when iron comes in contact with oxygen.

d. Physical
   - The breakdown of rock due to mechanical processes.
   - Abrasion is removing rock material as smaller particles of rock bang into other rock. Rocks in stream are constantly breaking small prices of to make the rocks smooth and round.
   - Biological is when living organisms such plant roots break rock as the plant grows.
   - Frost wedging is the result of water freezing in a crack. Water expands as it freezes and as a result the rock material cracks. Happens in only climates where freezing can occur.
     - Potholes form the same way in roads.

III. Factors affecting weathering rates

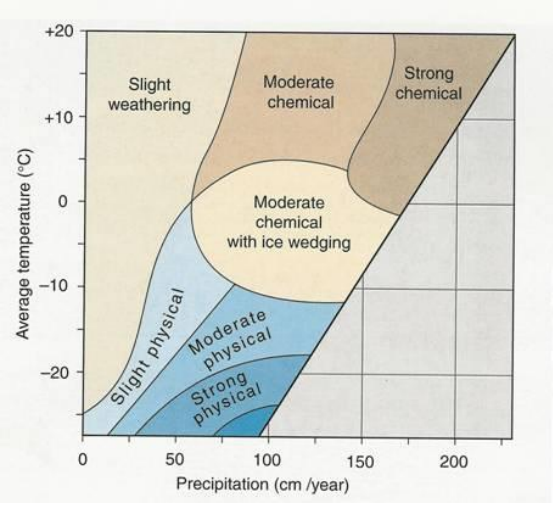
a. Exposure
   - Bare rock weathers faster
   - Rock closer to the surface weathers faster

b. Size of Particles
   - Smaller rocks compared to bigger rocks weather faster due to more surfaces (surface area) exposed to the environment.




The sample to the left has only 6 surfaces exposed to the environment, whereas the sample to the right has many more surfaces exposed to the environment. More surface area results in faster weathering.

c. Mineral Composition
   - The mineral composition affects how rock material breaks down. Lomestone and marble for exmple are made of calcite, Calcite chemically weahters quickly. Caves are formed in limestone because of this.

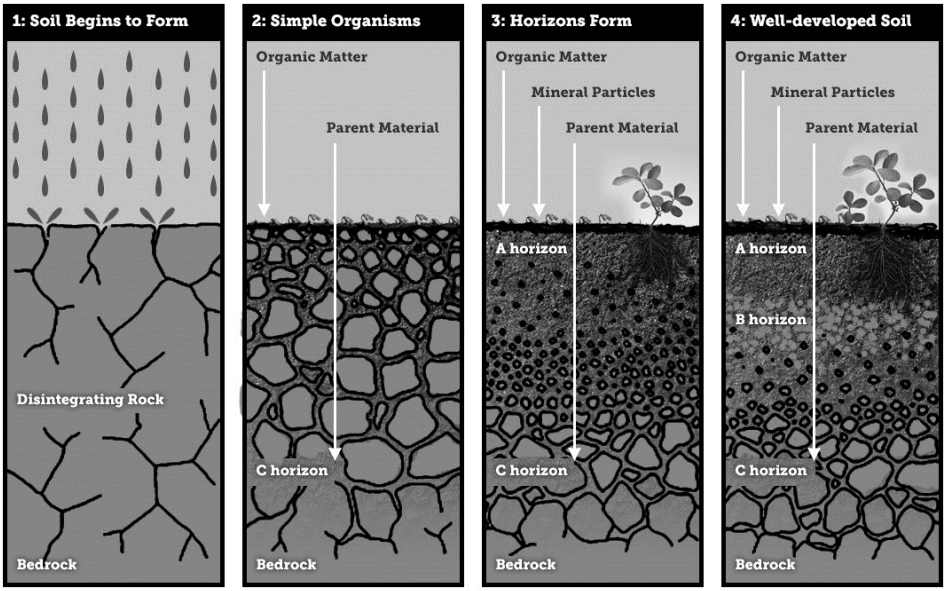



When the temperature and the amount of precipitation increase the amount of chemical weathering occurs.

Lower temperatures and often have greater physical weathering.

IV. Soil Formation

- Both chemical and physical weathering work together to break rock material down.
- Soil also is formed as the result chemical and physical weathering.
- Horizons are layers of soil, each represents different characteristics in the soil.




| Unweathered rock | Rock begins to break down into smaller pieces that fill in cracks. | Plant roots begin to grow in the newly added pieces. Both chemical and physical weather continue to break down rock even further. | As more plants grow, the more the weathering of the rock. At this stage soil is said to be well developed. |
|---|---|---|---|

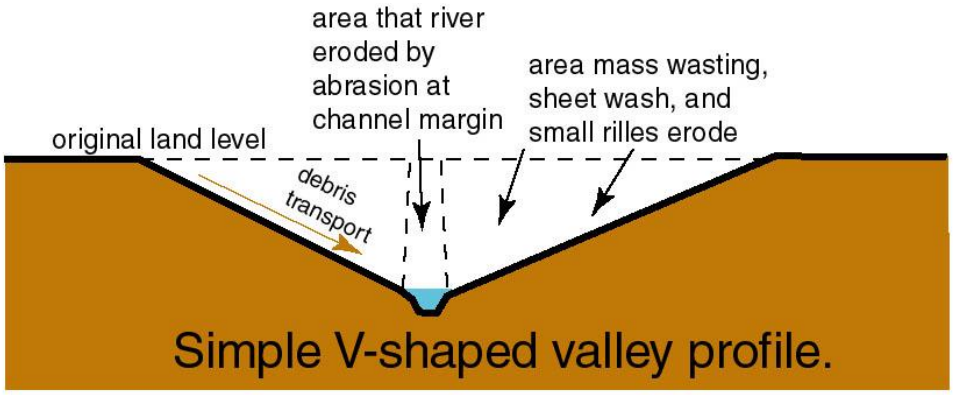
V. Erosion

- Once weathering occurs the particles are often moved to a new location through the process of erosion.
- There are several agents of erosion.
  - Water
  - Ice
  - Wind
  - Gravity

a. Water

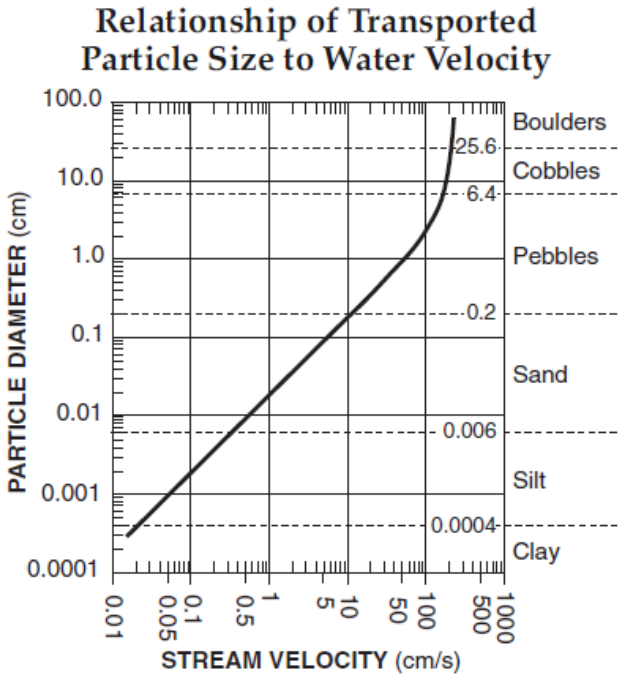
- The greatest erosive force in Earth. Water can move the most material.

1. Streams
   i. V-shaped valleys
      - Water erodes material and created a valley.




- All water in the stream's watershed will find its way into the valley. The bigger the water shed to wider the valley and the greater the stream discharge.

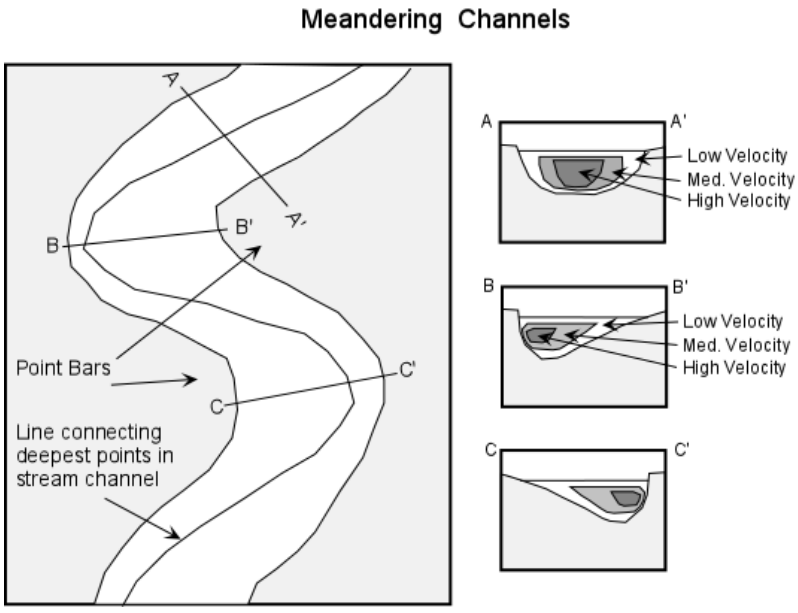
2. Stream velocity
   - The greater the velocity the greater the size of the particle can be carried by a stream. Page 6 of the ESRT.




The axis a logarithmic axis. Start the number 1 on either axis. Each tick mark is worth a value of 1 until you reach 10. At 10 the tick marks are a values of 10 until you reach 100. Values smaller than 1 decrease.

A stream velocity of 100 cm/sec can transport a 3.0 cm particle (pebble)

   - Stream velocity in its channel depend on the way the stream meanders.

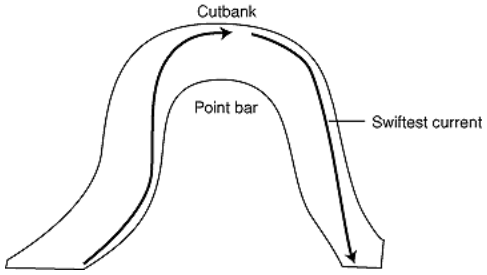



As the stream meanders in its channel the greatest velocity moves towards the cut bank. When the stream is straight the velocity is greatest in the middle.

- As the stream meanders it widens its valley into a flood plain. During flood events water spreads into the flood plain.

3. Erosion in a Stream

Streams erode where the water is moving fast enough to carry particles in the water.

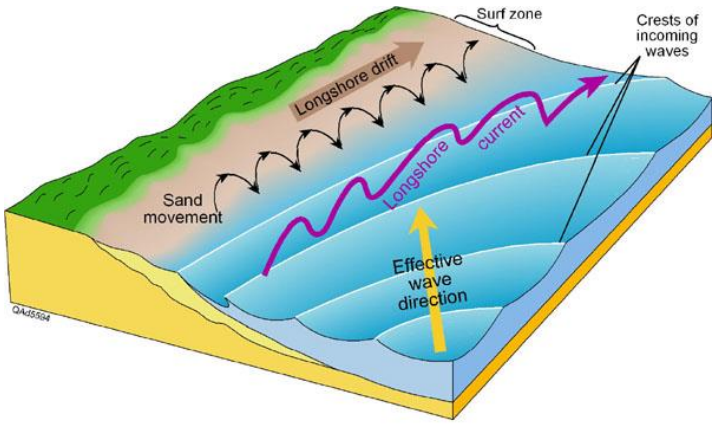



At cut banks the water is moving fastest and is removing material to be deposited in slower moving water. Streams change course because of removing material from cut banks.

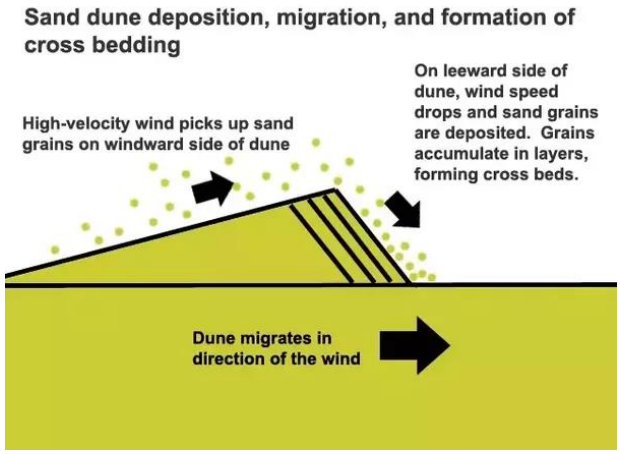
Streams also erode when the slope is great, this is how streams cut downward into rock layers. The Grand Canyon is an example of water cutting into rock

The faster the water moves in a stream the greater the erosion,

4. Wave action
    - Waves from oceans and lakes shape the shoreline by removing sediment and transporting it elsewhere.
    - Beaches are created from eroding material elsewhere and depositing the material in a new location.

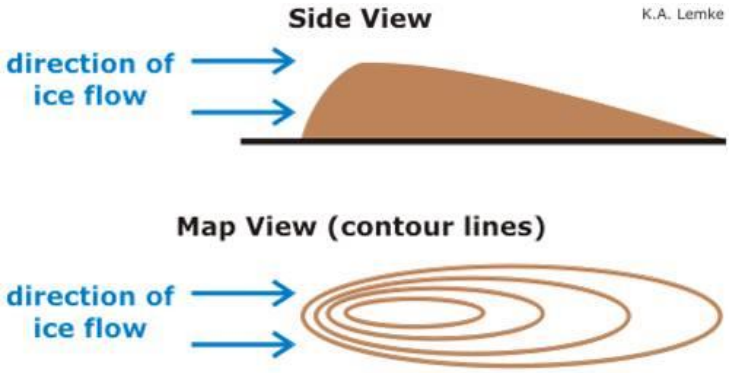



b. Wind
    - In areas where there is very little vegetation or no vegetation the wind will blow small particle forming sand dunes.
    - Dunes can from in deserts and along beaches.



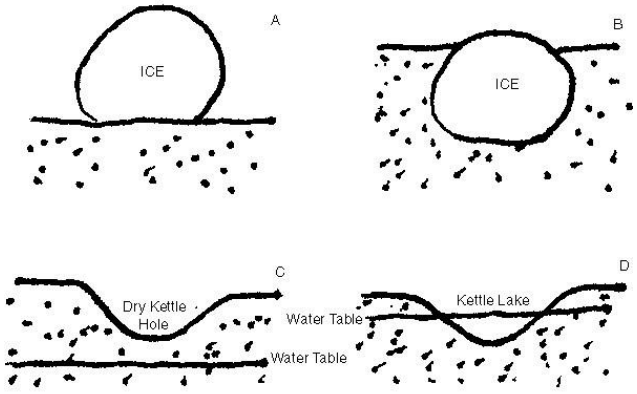
c. Glacial
   - Ice moves large amounts of sediment as the result of ice flows, very slowly
   - Several features created by glaciers are (most common on Regents)

**Drumlins**



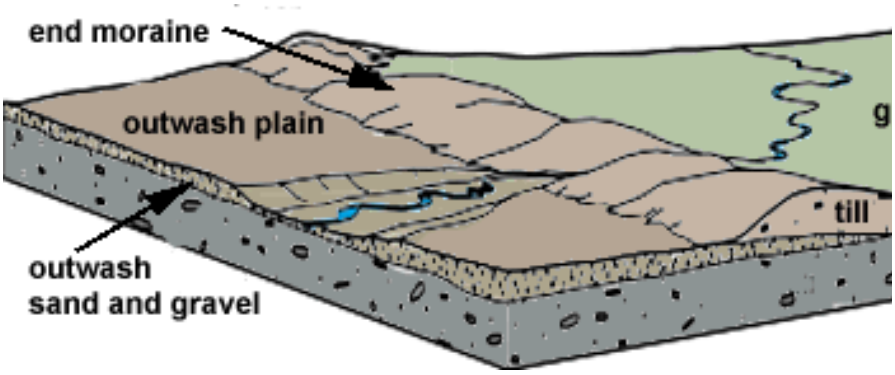

In New York State the steep end of the points north or northeast. That means the glacier flowed from the north. The contour map shows the steep side with the contour lines close together. Often a Regents question will ask direction of flow and there will be no North direction indicated.

**Kettle lakes**




These are small round deep lakes formed from a melting piece of glacial ice.

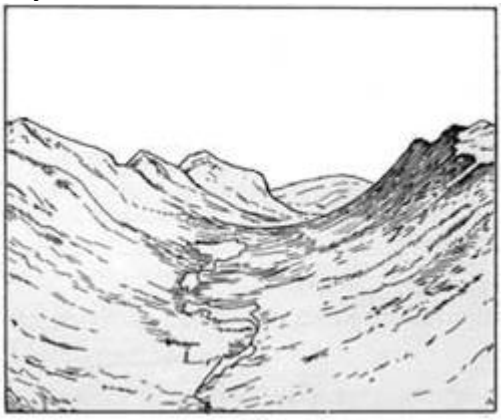
**Moraines**




Moraines form at the edges of a glacier. Moraines can be very high blocking river valleys. Glacial moraines are responsible for blocking the flow of rivers to form the Finger Lakes in central New York. The till material is unsorted, because the ice left pushed it there.

Outwash plain contains material that is left over when the glacier melts, the material is sorted by size. Water sorts particles by size, even if it is melting ice.

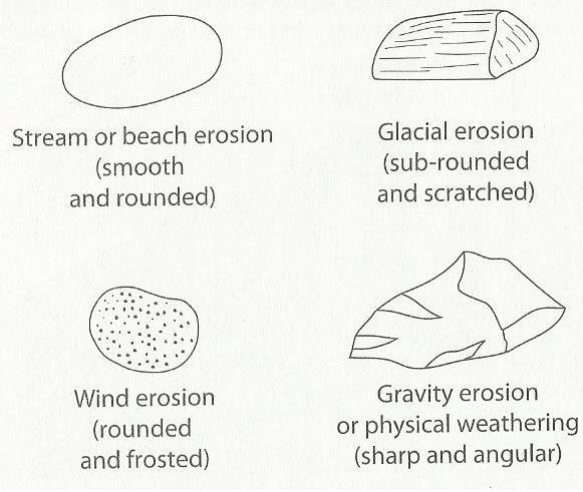
**U- shaped valleys**



U-shaped valleys are wide and they have a characteristic U-shape to them. As the ice was flowing in the valley ice carved out the rock material leaving behind a valley.

VI. Features of Eroded Sediment

Sediments that have been exposed to the agents of erosion have distinguishable characteristics as a result.

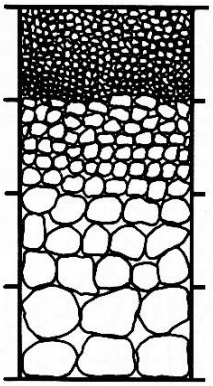


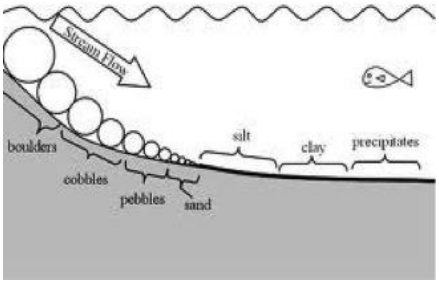
VII. Deposition

It is the result of sediment being released by the agent of erosion. Recall agents of erosion are water, wind ice and gravity. Deposition will either be sorted or unsorted particles.

a. Sediments and Deposition Rates

**Size**



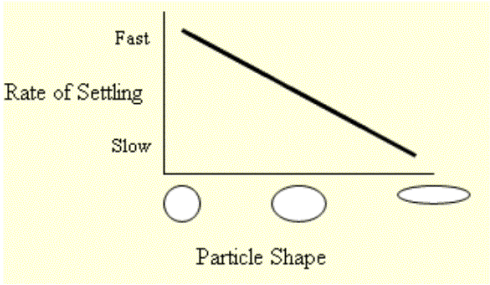



Delta deposition

If the density of particle are equal then larger particles will settle first in wind and water environments. The particles will sorted with larger particles at the bottom and smaller at the top.

Sand dunes, deltas and point bars have sorted particles.

**Shape**




Round particles versus flat particles settling in still water. Flat particles settle slower and will settle on top of rounded particles.

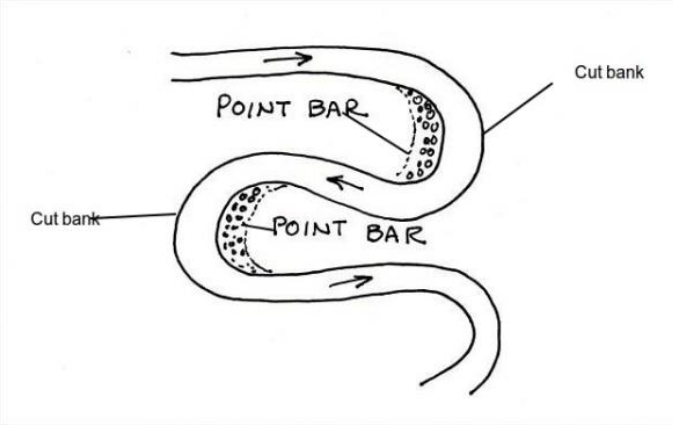
**Density**

The more dense a particle is the faster it will settle in still water.

b. Deposition in a Stream Sorts Particles

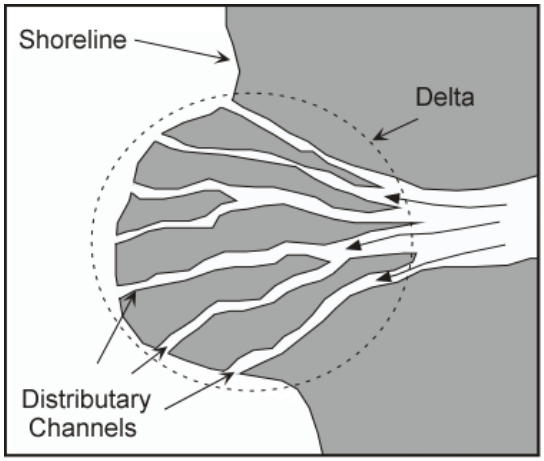
In stream systems deposition occurs in the delta and the point bars. Streams do move in their channels seasonally and during flood events.

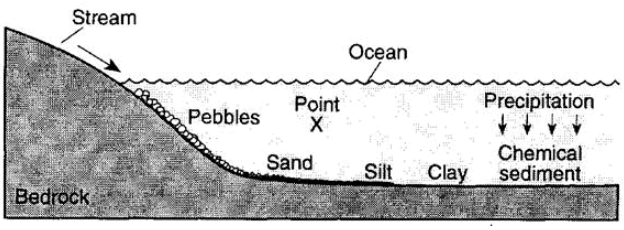
**Point bars**




Opposite the cut bank is the point bar. The water velocity at the point bar is slower than the cut bank, therefore the sediments are released and deposited creating new land. As a stream meanders the cut banks move and the point bars increase in size.

**Delta**




As river enters a large body of water (lake or ocean) a delta often forms. When the water of the stream meets the water of the large body the velocity slows down.

The top image shows a delta as it forms at a shoreline.

The bottom image shows where the particles will settle in a delta. In addition future sedimentary rock will form from these particles.

c. Deposition by Wind and Sort Particles

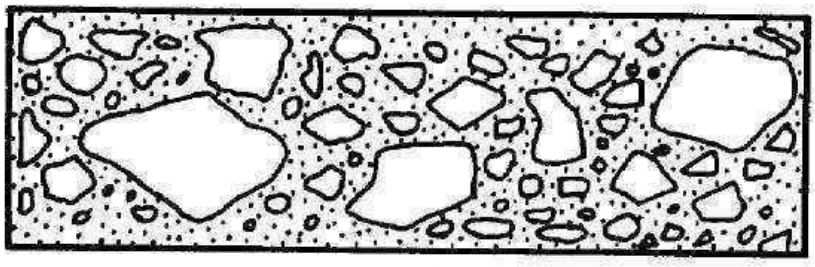
Wind sorts particles much like water, however wind can only sort the smallest particles. In dunes you would see bedding patterns as the wind deposits particles.

d. Deposition by Ice and Unsorted Particles

Drumlins and moraines leave unsorted particles behind. Ice does not sort.

Page 3 of the ESRT shows some areas of New York State (Long Island) having unconsolidated material, meaning it is not rock. Long Island is a series of glacial moraines.

The illustration below shows materials of various sizes of sediment that make up glacially deposited soil.



VIII. Landscape Development

Water, wind, ice, tectonic forces and meteors all shape the surface of our planet. The Regents will most likely focus on stream drainage patterns, and features comparing water created landscapes and glacial created landscapes.

a. ESRT page 2

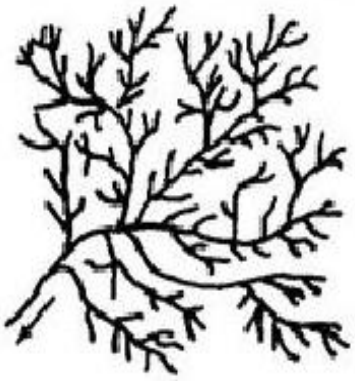
Page 2 shows the major landscape regions in New York State. Page 2 can be used with page 3 to determine the bedrock structure common in a particular landscape region.

b. Drainage Patterns

Water creates drainage patterns based on the bedrock and how bedrock is deposited on Earth's surface.

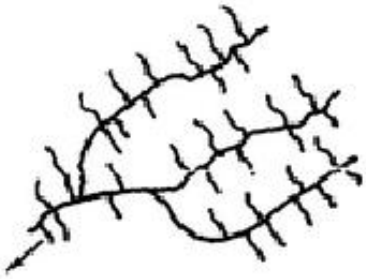
Several drainage patterns are illustrated below with a brief description.

Dendritic



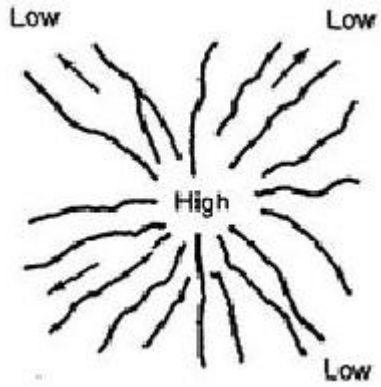
This is randomly developed in a treelike pattern with branching tributaries. It is the most common drainage system found on flat lying bedrock and soils.

Trellised



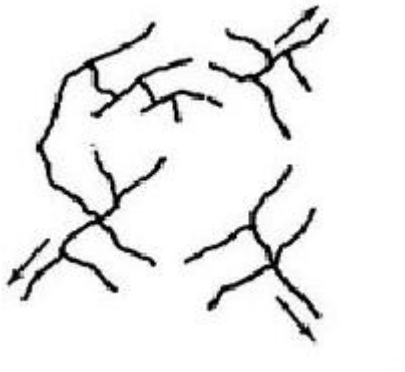
This drainage pattern forms in areas of folded rock layers on the surface. The main stream flows in the low lands while the tributaries are at right angles from the adjacent ridges that separate the main streams.

Radial




Radial drainage is composed of streams radiating outward from a central peak such as a mountain or a volcano.

Annular



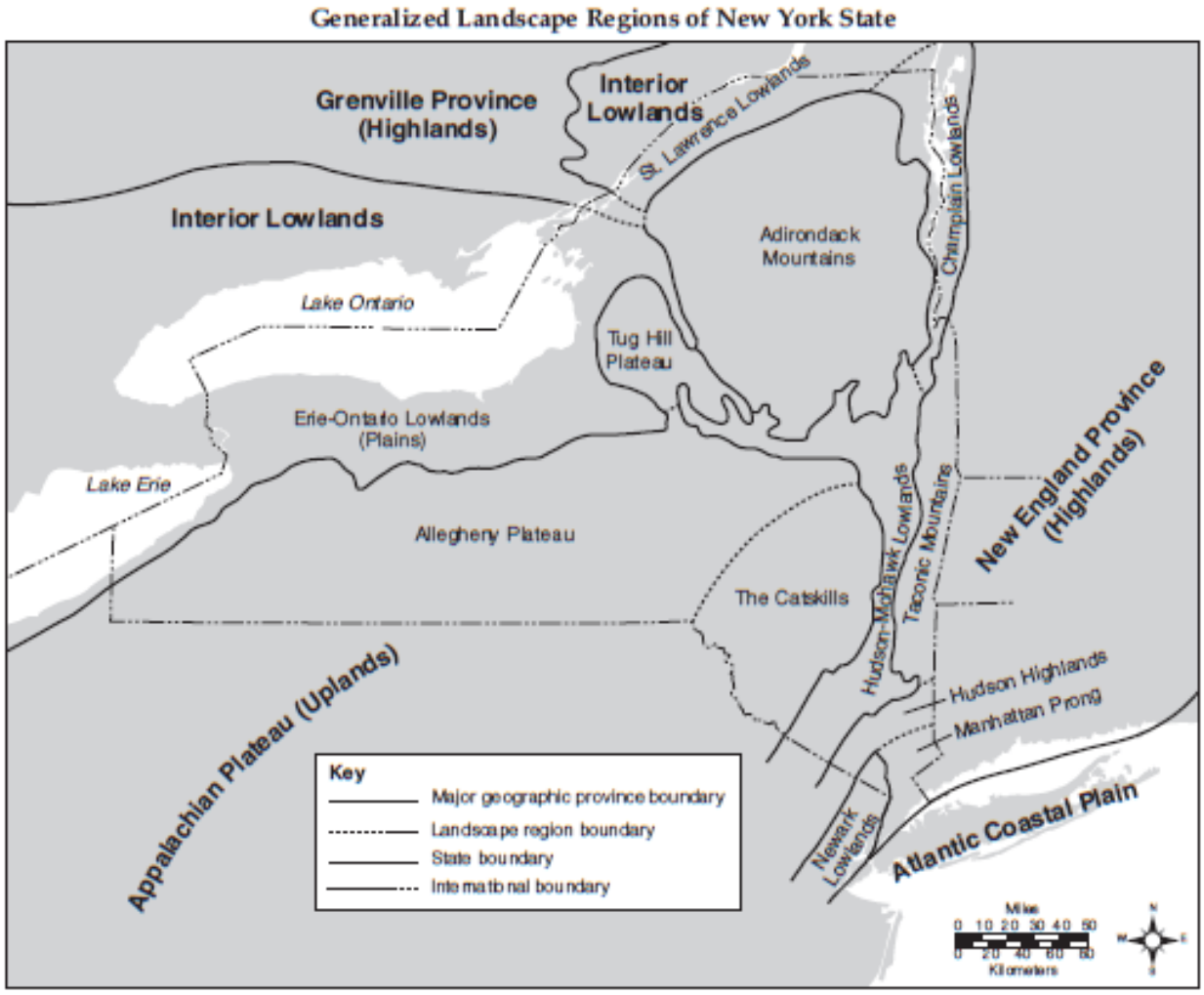
Annular streams develop in circular joints from up lifting domes in sedimentary rocks.

# Earth Science Reference Table – (ESRT)

Pages from ESRT used in Topic 12.

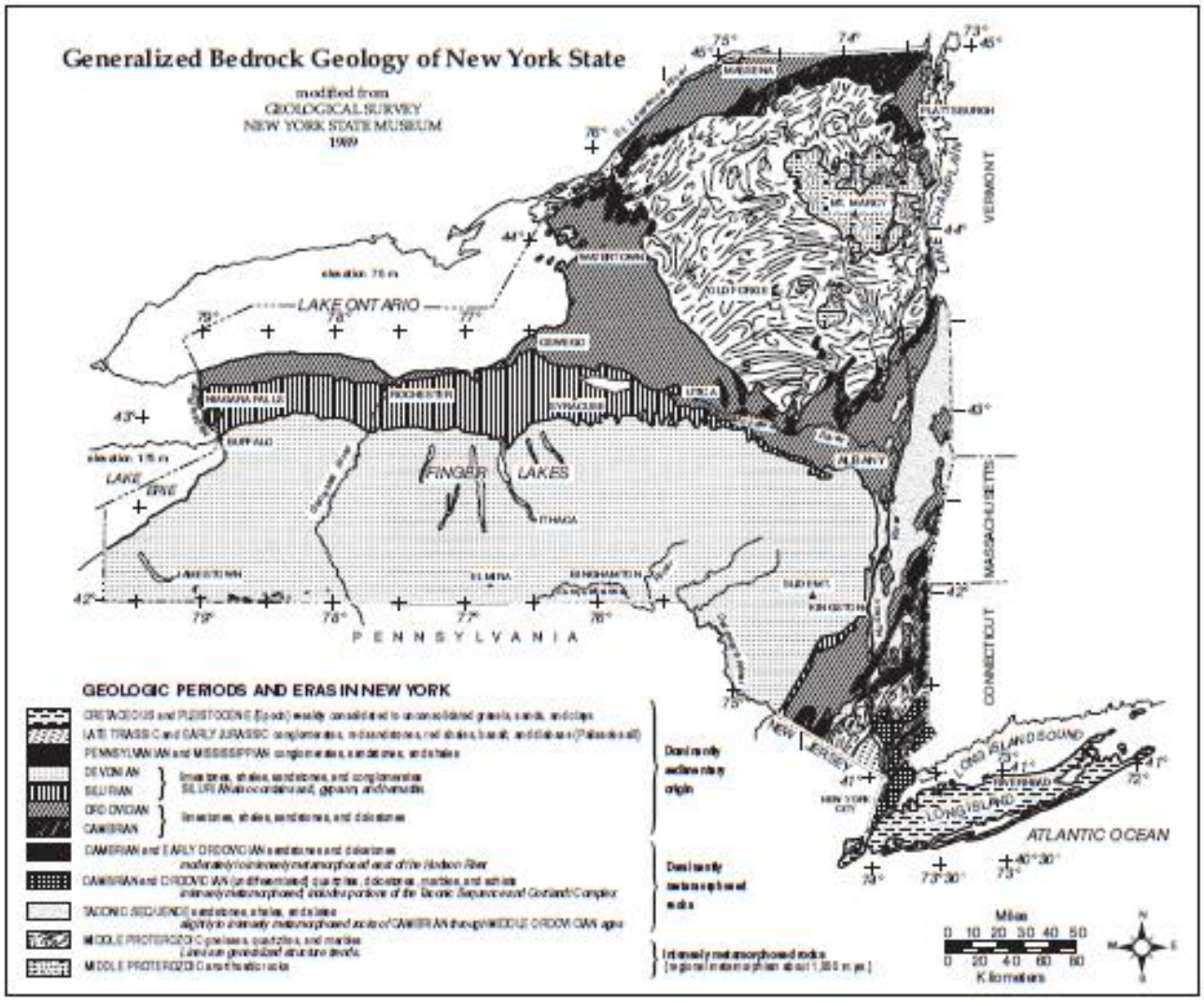
***Page 2, 3 and 6***

Page 2




This table is useful for finding the landscape regions. The boundary lines also correspond to page 3 of the ESRT. The boundary line between the Erie-Ontario Lowlands and the Allegheny Plateau corresponds to the boundary on between bedrock types. These maps can be used together.

Also the map has a distance scale to assist in determining distances.




This map when used with page 2 of the ESRT can help determine dominant bedrock types in the landscape regions in NY State. Also it shows the origin of the rock or sediment found in the landscape regions. The Era of the bedrock is also given.

This table also has latitude and longitude, cites, points of interest, lakes, rivers and a scale of distance on it. The major rivers that are found in NY are labeled.

It is helpful for students to lightly draw the lines of latitude and longitude with a pencil.

**Example problem**

Syracuse is located at a latitude of 43$^{o}$N. What is the bedrock age and the landscape region that Syracuse is found?

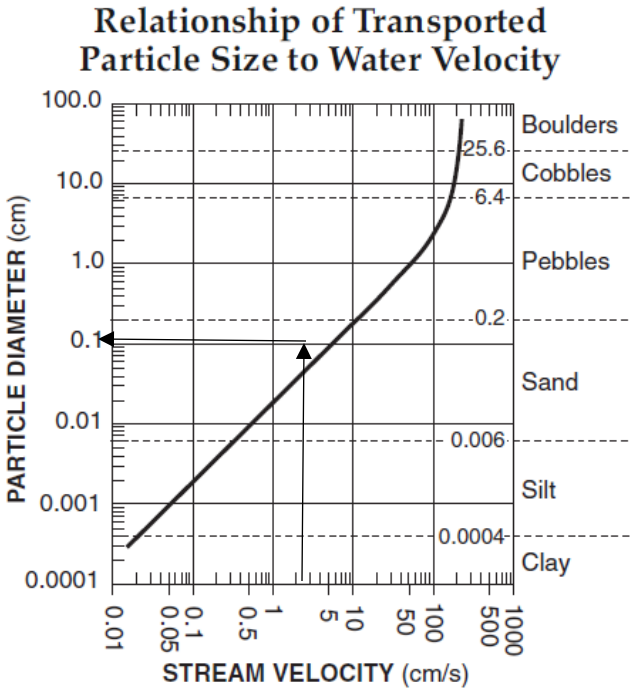
Look on page 3 for 43°N and Syracuse. Use the symbol of the bedrock material at Syracuse and look at the key on page 3 to find the age. Now look at page 2 to find the corresponding landscape region where Syracuse is located.

Age of bedrock – Silurian

Landscape region – Erie Ontario Lowlands

You could take it one step further and find an index fossil that would be found in Silurian bedrock in NY State. Use page 8 & 9 of the ESRT. Find the row where the Silurian Era is located. Continue until you reach the Time Distribution of Fossils in New York State. There are several fossils in Silurian bedrock. You could choose anyone that is located there, *Cooksonia* is one example.

Page 6




This is a simple chart to use, only it looks confusing. Use the x-axis and they y-axis on the left. Particle sizes are separated out between dotted lines to help give an idea of what size particle water can move.

**Example**

A stream is flowing at 5 cm/sec what size particle can the stream carry?

Look for 5 cm/sec on the x-axis and make an arrow in pencil until it intersect the dark line, then make another line to the y-axis to find the diameter.

The diameter is 0.1 cm, which is sand.

NOTE – The scale on both the y-axis and the x-axis are logarithmic.