Your Name _____ Score _____

Group Members _____ _____ Minutes _____

Performance Indicator 2.1

Standard 4
Key Idea 2

Use the concepts of density and heat energy to explain observations of weather patterns, seasonal changes, and the movements of Earth's plates.

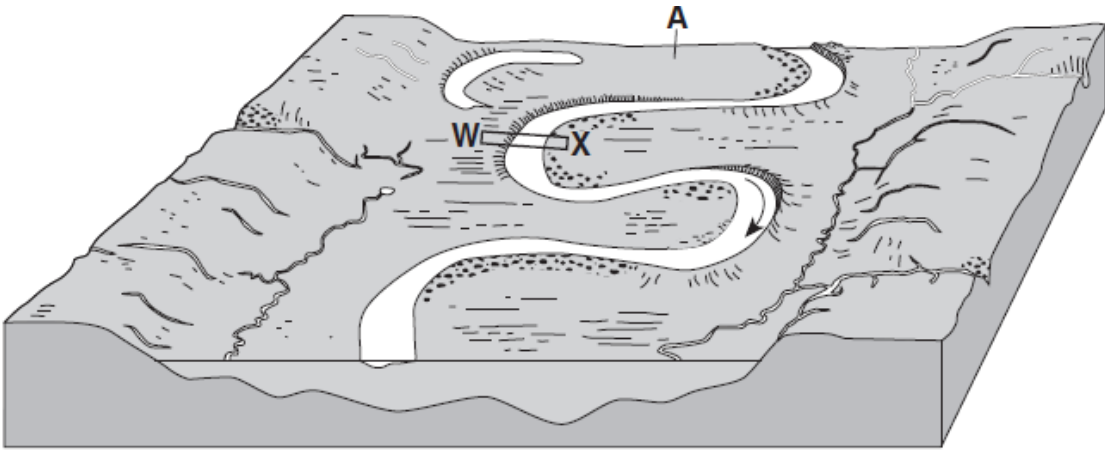
Major Understanding:

2.1t Natural agents of erosion, generally driven by gravity, remove, transport, and deposit weathered rock particles. Each agent of erosion produces distinctive changes in the material that it transports and creates characteristic surface features and landscapes. In certain erosional situations, loss of property, personal injury, and loss of life can be reduced by effective emergency preparedness.

2.1u The natural agents of erosion include:

- *Streams (running water):* Gradient, discharge, and channel shape influence a Stream's velocity and the erosion and deposition of sediments. Sediments transported by streams tend to become rounded as a result of abrasion. Stream features include V-shaped valleys, deltas, flood plains, and meanders. A watershed is the area drained by a stream and its tributaries.
- *Glaciers (moving ice):* Glacial erosional processes include the formation of U-shaped valleys, parallel scratches, and grooves in bedrock. Glacial features include moraines, drumlins, kettle lakes, finger lakes, and outwash plains.
- *Wind:* Erosion of sediments by wind is most common in arid climates and along shorelines. Wind-generated features include dunes and sand-blasted bedrock.

2.1v Patterns of deposition result from a loss of energy within the transporting system and are influenced by the size, shape, and density of the transported particles. Sediment deposits may be sorted or unsorted.

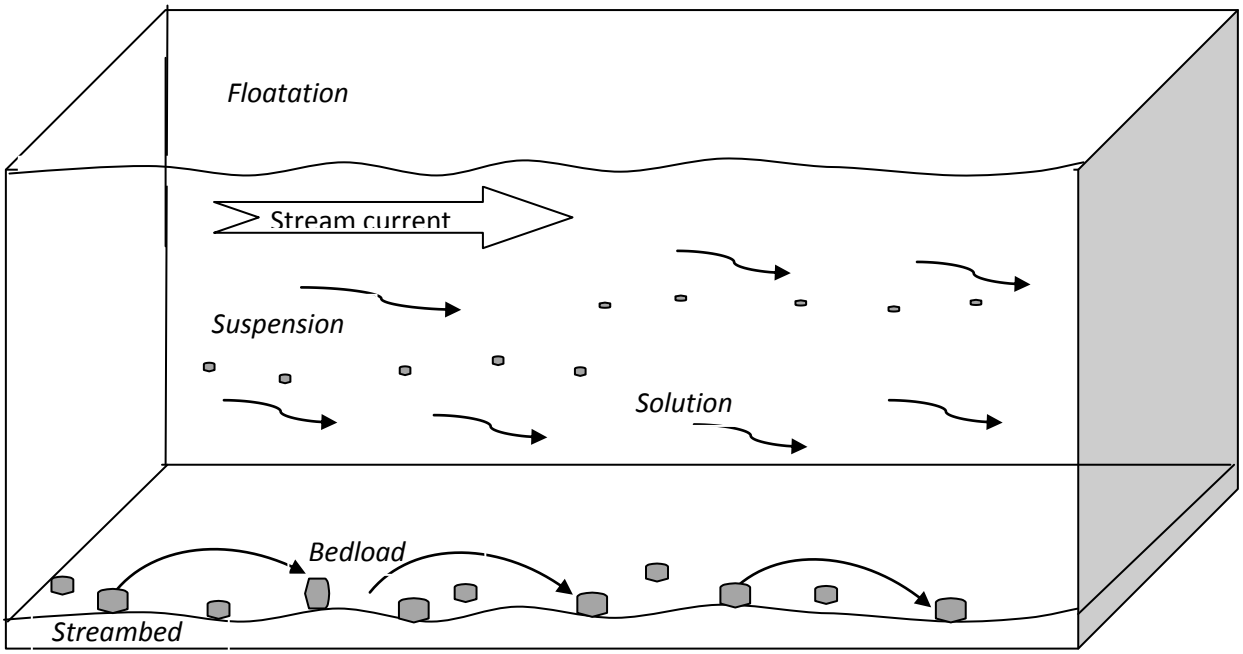


Mini Lesson 1: Erosion by Running Water

A stream is any body of water with a current. It includes brooks, creeks, tributaries and rivers. Running water is the most erosive agent. Gravity causes water to flow downhill. Sediments are weathered by abrasion and become smaller, rounder and smoother. The faster the water moves, the larger the particles it can transport. As the water slows down, the larger, rounder, more dense particles settle out first. Sediments carried in a stream move slower than the water.

Transportation of sediment in a stream

- Floatation - Materials that float on the water (ex. branches)
- Solution - Sediments are dissolved in the water (ex. Salt)
- Suspension - Sediments that remain mixed within the water (ex. clay and silt)
- Bedload - Sediments that bounce(saltation) and roll (traction) on the stream bed (ex. pebbles and sand)



Need to know:

1. What is a stream? _____
2. Give four examples of streams. _____ , _____ , _____ , _____
3. How does gravity affect running water? _____
4. What type of physical weathering occurs as sediments are transported by a stream? _____
5. What happens to the size, shape, and texture of a sediment as it is transported by a stream?

_____	_____	_____
size	shape	texture

ES Reference Tables page 6 "Relationship of Transported Particle Size to Water Velocity"

The graph below shows the water velocity needed keep different sized particles moving in a stream. This same graph is in your Earth Science Reference tables. Four thin lines have been added to illustrate the increase in particle size able to be transported.

1. What page is this chart located on, in the Earth Science Reference Tables? _____

2. Highlight the vertical thin lines that have been added to the chart on the right.

3. For each of the lines highlighted, write in the approximate streams velocity at the bottom of the chart. The first thin line on the left is *.02 cm/s.*

4. For each of the following particle sizes, write the minimum stream velocity needed to maintain movement.

Clay < 0.02 cm/s

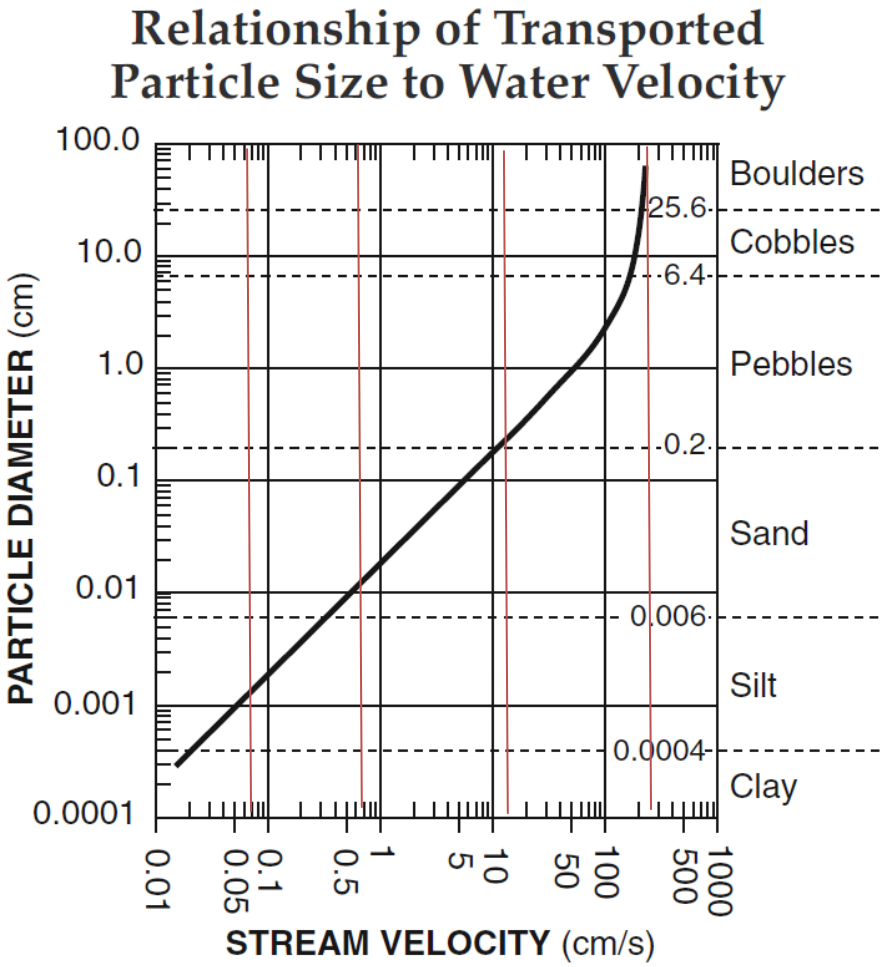
Silt _____ cm/s

Sand _____ cm/s

Pebbles _____ cm/s

Cobbles _____ cm/s

Boulders _____ cm/s



This generalized graph shows the water velocity needed to maintain, but not start, movement. Variations occur due to differences in particle density and shape.

5. State the relationship between stream velocity and particle size moved by the stream. Write it out completely.

_____

_____

6. In order to keep particles suspended in the stream, what is true about its velocity?

_____

_____

Regents Questions:

_____1. What is the largest rock particle that can be transported by a stream with a velocity of 250 centimeters per second?
(1) silt (2) pebbles (3) sand (4) cobbles

_____2. What is the approximate minimum stream velocity needed to keep a particle with a diameter of 25.6 centimeters moving?
(1) 100 cm/sec (2) 200 cm/sec (3) 300 cm/sec (4) 400 cm/sec

_____3. Which is the largest sediment that could be carried by a stream flowing at a velocity of 75 centimeters per second?
(1) silt (2) pebbles (3) sand (4) cobbles

_____4. The velocity of a stream is 100 centimeters per second. What is the largest diameter particle that can be transported?
(1) 0.001 cm (2) 0.01 cm (3) 0.1 cm (4) 1.0 cm

_____5. What is the maximum size particle that can be carried by a stream having a velocity of 300 centimeters per second?
(1) 0.002 cm (2) 0.02 cm (3) 0.2 cm (4) 20 cm

_____6. A mixture of the sediments listed below is being carried by a river that empties into a lake. Assuming that all four sediments arrived at the mouth of the river together, which sediment will probably be carried farthest into the lake by the river current?
(1) clay (2) sand (3) pebbles (4) silt

_____7. A pebble is being transported in a stream by rolling. How does the velocity of the pebble compare to the velocity of the stream?
(1) The pebble is moving slower than the stream.
(2) The pebble is moving faster than the stream.
(3) The pebble is moving at the same velocity as the stream.

_____8. What is the largest particle that can be kept in motion by a stream that has a velocity of 100 centimeters per second?
(1) silt (2) pebbles (3) sand (4) cobbles

_____9. A stream with a water velocity of 200 centimeters per second decreases to a velocity of 100 centimeters per second. Which sediment size will most likely be deposited?
(1) pebbles (2) boulders (3) sand (4) cobbles

_____10. What is the minimum rate of flow at which a stream of water can maintain the transportation of pebbles 1.0 centimeter in diameter?
(1) 50 cm/sec (2) 100 cm/sec (3) 150 cm/sec (4) 200 cm/sec

Velocity of a stream is influenced by gradient (slope), the amount of water in the stream - volume (discharge), shape of the channel and amount of sediment in the stream.

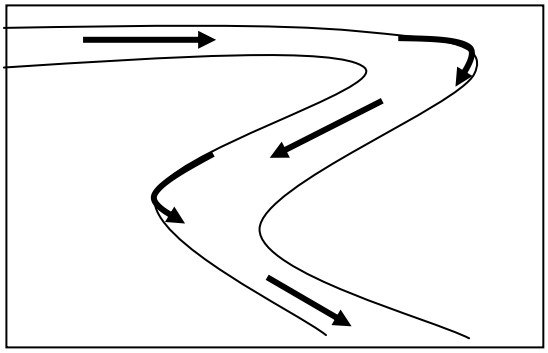
1. Complete the statements below by circling the correct word or words that describes the conditions necessary for the stream to flow faster.

(a) Gradient : The (*steeper / gentler*) the slope, the faster the water flows.

(b) Volume: (discharge – the amount of water flowing past a fixed point each second)
The (*less water / greater the amount of water*) in the stream, the faster the water flows.

(c) Amount of sediment in the stream:
- A stream with a lot of sediment in it will flow (faster / slower) than a stream without a lot of sediment.
- The sediment in the stream will always flow (faster / slower / at the same rate) as the water that carries it.

(d) Shape of stream channel — The arrows shown in the diagram below illustrates where the velocity of the stream is the greatest. The curves in a stream are called meanders.



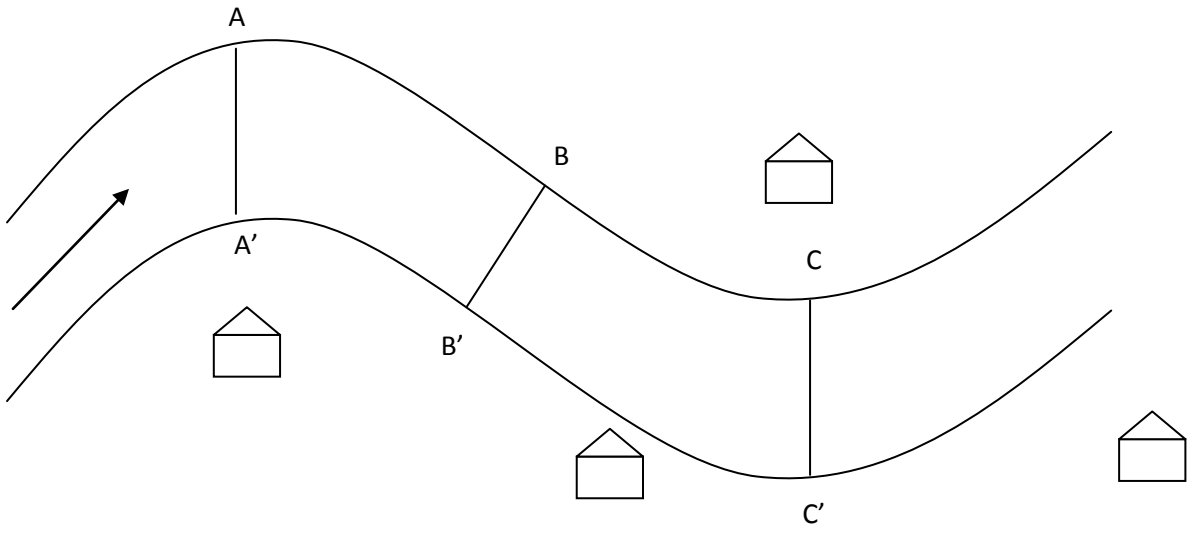
_____1. Water moves quickest through the
(1) straight smooth section of the stream
(2) meanders - curves

_____2. In a straight section of a stream the water moves fastest
(1) at the top of the water
(2) just below the surface
(3) at the bottom of the channel

_____3. Weathering and erosion takes place where the water flows the
(1) fastest (2) slowest

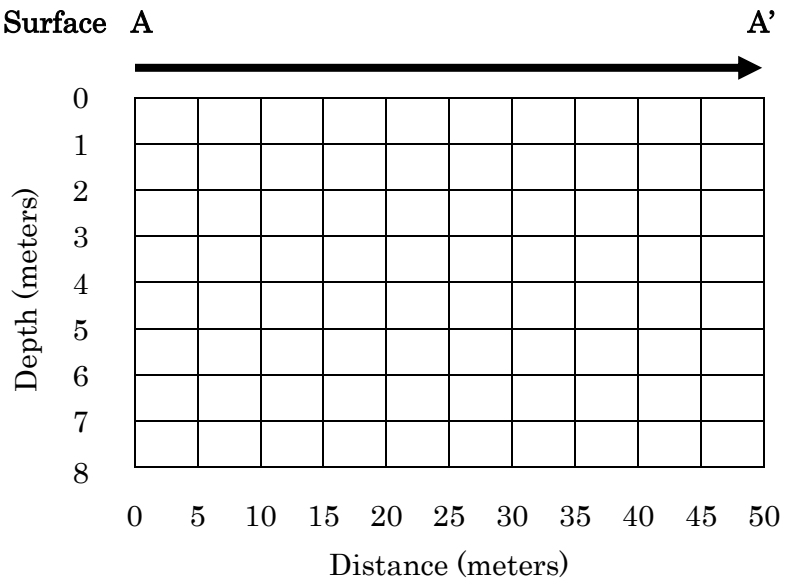
4. Water flows fastest on the (outside / inside) of a meander.
5. Erosion takes place primarily on the (outside / inside) of a meander.
6. Water flows slowest on the (outside / inside) of a meander.
7. Deposition takes place primarily on the (outside / inside) of a meander.
8. Place the letter "E" next to the arrows on the outside of the meanders (curves).
9. Place the letter "D" (deposition) next to the inside of the meanders (curves).

Not only does erosion cut farther into the bank of the stream, it also erodes the bottom of the stream bed. Plot the data from the three tables below on to the corresponding graphs. Create a profile for each section by connecting the plotted points. On the lines to the right, explain the processes that caused each profile to look as it does.



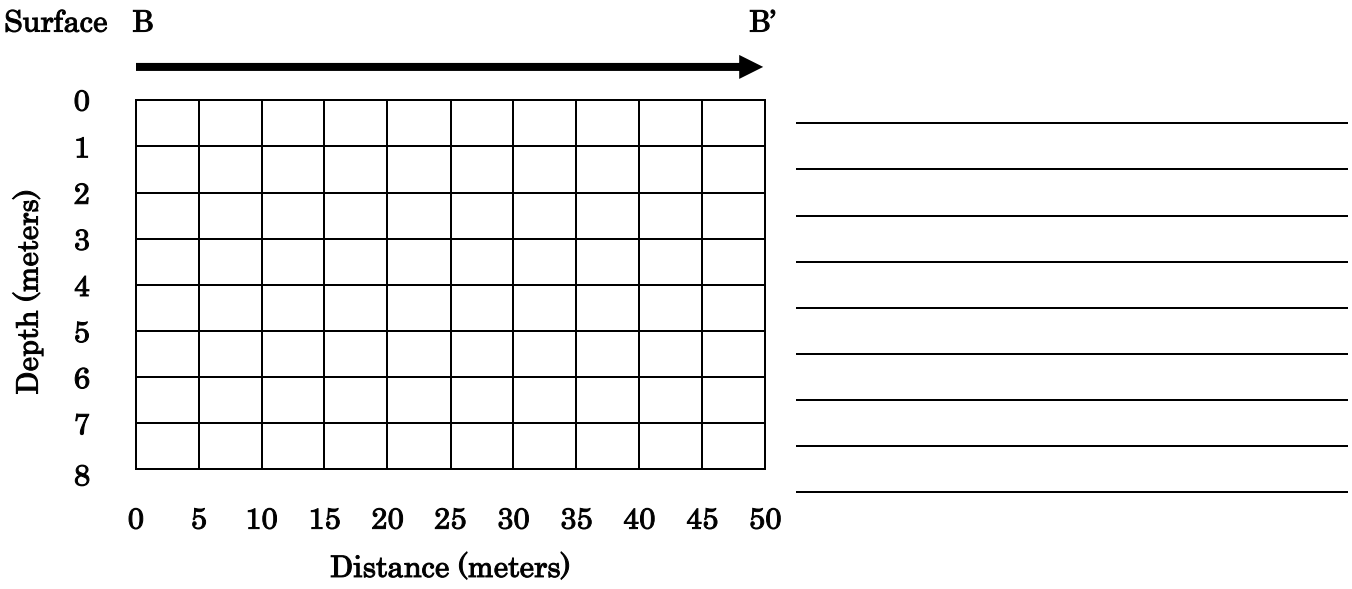
A to A'

Distance (m)	0	5	10	15	20	25	30	35	40	45	50
Depth (m)	0	4.0	6.5	6.0	5.0	3.0	1.5	1.0	.75	.5	0



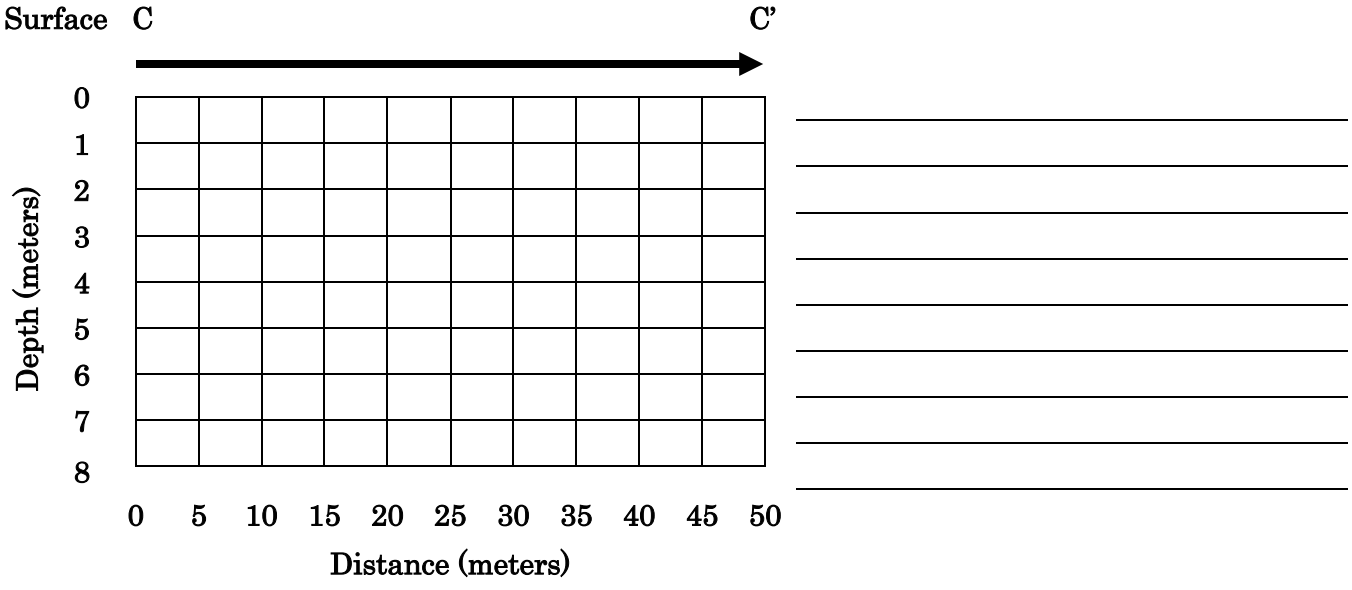
B to B'

Distance (m)	0	5	10	15	20	25	30	35	40	45	50
Depth (m)	0	2.0	4.0	5.5	6.0	6.5	6.0	5.0	4.0	2.0	0



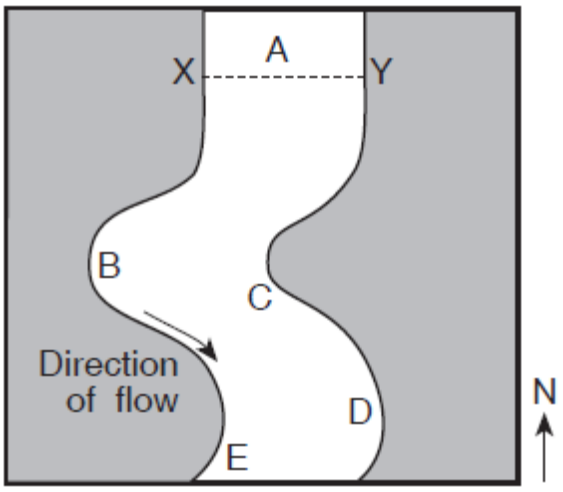
C to C'

Distance (m)	0	5	10	15	20	25	30	35	40	45	50
Depth (m)	0	.5	.75	1.0	1.5	3.0	4.5	6.0	6.5	4.5	0



Regents Questions:

Base your answers to questions 1 through 3 on the map to the right, which shows a portion of a stream in New York State that flows southward. Letters A through E represent locations in the stream. Line XY is the location of a cross section.



____1. At which two locations in this stream is deposition normally dominant over erosion?

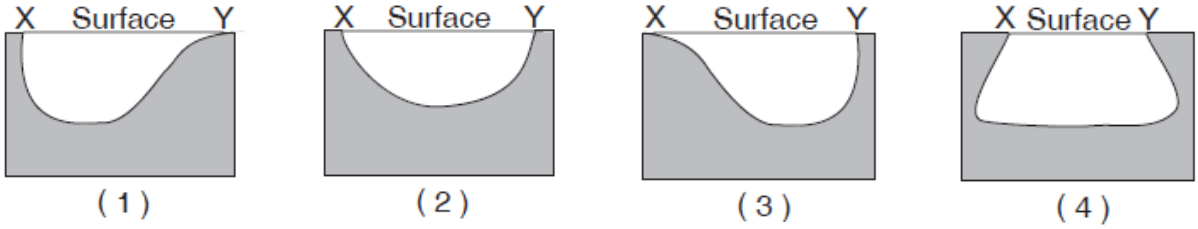
(1) A and D (3) C and E

(2) B and E (4) D and C

____2. Where this stream's velocity decreases from 300 to 200 centimeters per second, which size sediment will be deposited?

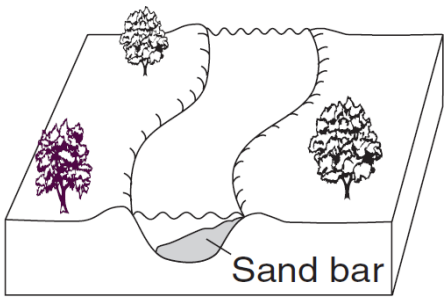
(1) cobbles (2) sand (3) silt (4) clay

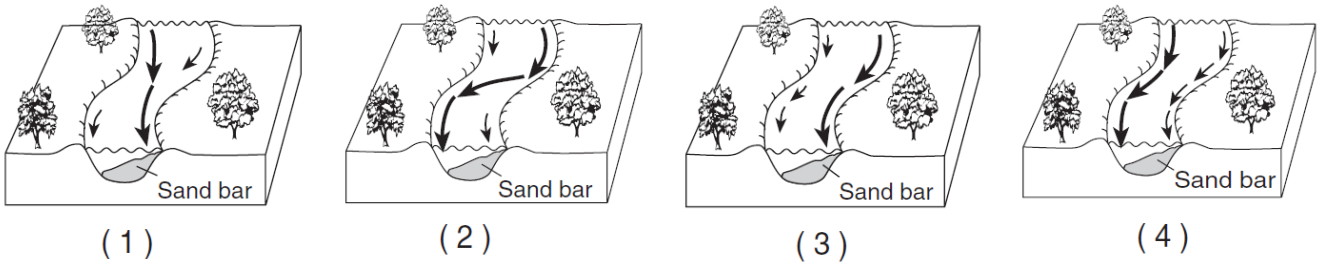
____3. Which cross section along line XY best represents the shape of the stream bottom?



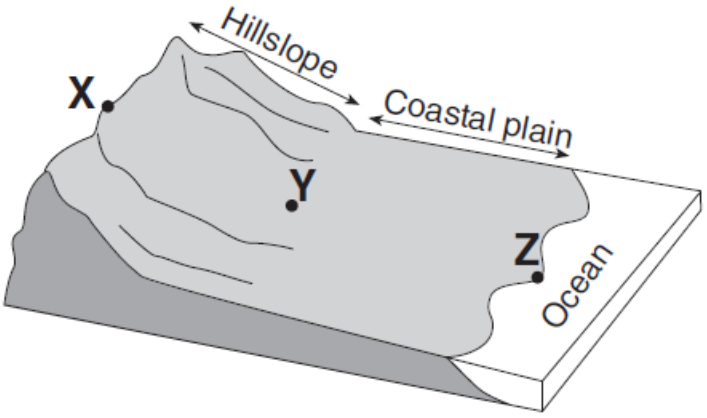
____4. The diagram to the right shows a meandering stream flowing across nearly flat topography and over loose sediments.

If arrow length represents stream velocity, which diagram best shows the relative stream velocities in this section of the stream?

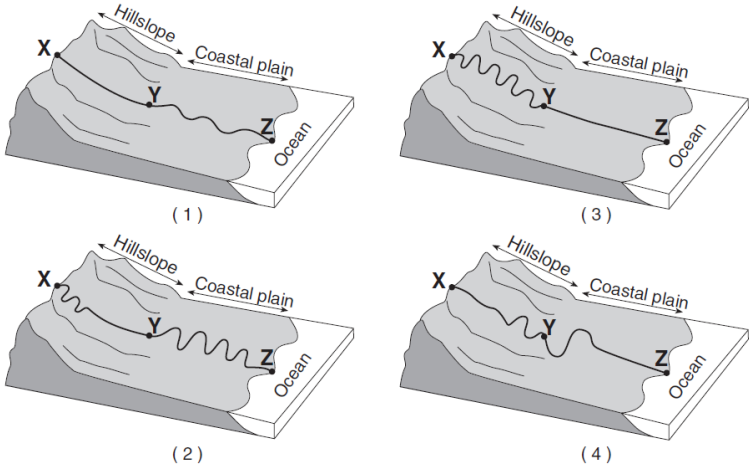




Base your answers to questions 5 through 7 on the diagram to the right, which shows a coastal region in which the land slopes toward the ocean. Point X is near the top of the hill, point Y is at the base of the hill, and point Z is a location at sea level. The same type of surface bedrock underlies this entire region. A stream flows from point X through point Y to point Z. This stream is not shown in the diagram.

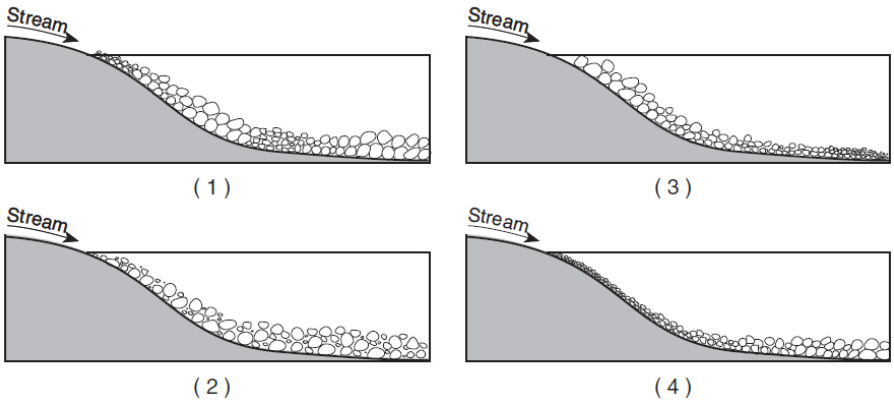


_____5. Which diagram best shows the most probable path of the stream flowing from point X to point Z?



_____6. Compared to the stream velocity between point X and point Y, the stream velocity between point Y and point Z is most likely
(1) greater, since the slope of the land decreases
(2) greater, since the slope of the land increases
(3) less, since the slope of the land decreases
(4) less, since the slope of the land increases

_____7. Which cross section best shows the pattern of sediments deposited by the stream as it enters the ocean near point Z?



Mini Lesson 2: Life and Features of a Stream

Life of a Stream

- **Youth**: high energy, fast moving, steep gradient (slope), a lot of erosion river creates a narrow "V" shaped valley
- **Mature**: gentler gradient, slower moving water, side walls of the "V" shaped valleys collapse, meanders develop, valley becomes wider than the river channel, flood plains develop (where the excess water goes when the river overflows)
- **Old Age**: land is almost flat, levees form - a place around a stream where deposition over time, deposits a mound of sediments
  oxbow lake – a cut off meander forms from deposition

Formation of Oxbow Lakes

- Form by erosion along the outside banks of a curve in a meandering stream
- Eventually stream continues on a straight path and sediments are deposited cutting off the meander
- The cut off meander becomes the oxbow lake.

Formation of Deltas

- as a river empties into a larger body of water, deposition occurs
- when deposition exceeds the amount of sediment moved by waves and tidal action, deltas form

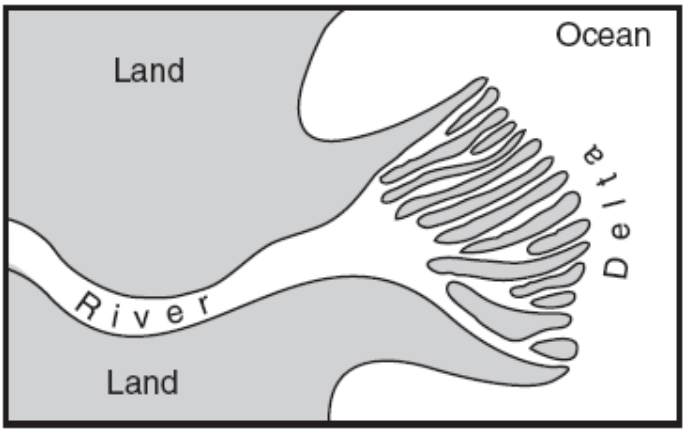
- Remove the last page of the packet
- Cut out the diagrams in the section labeled "**Stages in Stream Development**"
- Glue the diagrams in correct order from Youth through Old Age in the spaces provided below.

Youth	**Mature**	**Old Age**

- Cut out the diagrams in the section labeled "**Formation of an Oxbow Lake**"
- Glue the diagrams in correct order in the spaces provided below.

(1)	(3)
(2)	(4)

- Draw an arrow in the river to show the direction of flow
- Draw and label an arrow to show where sediments are deposited



Terms:

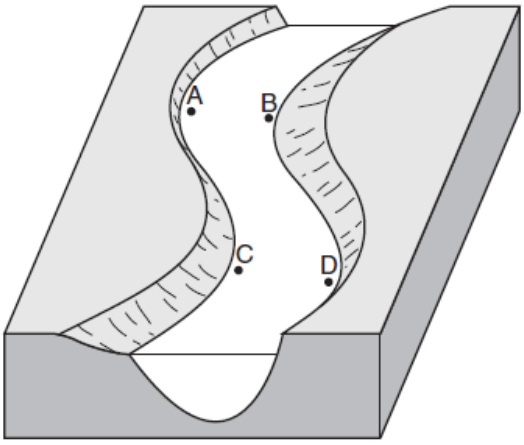
Drainage basin - the area where water from precipitation drains downhill into a body of water
- includes streams and land areas

Watershed - an area where water flows from
- surface water (runoff) that feeds a river

Tributary - - a creek or stream that flows into a larger body of water

Regents Questions

Base your answers to questions 1 through 3 on the diagram below, which shows a meandering stream. Letters A, B, C, and D indicate locations on the streambed.

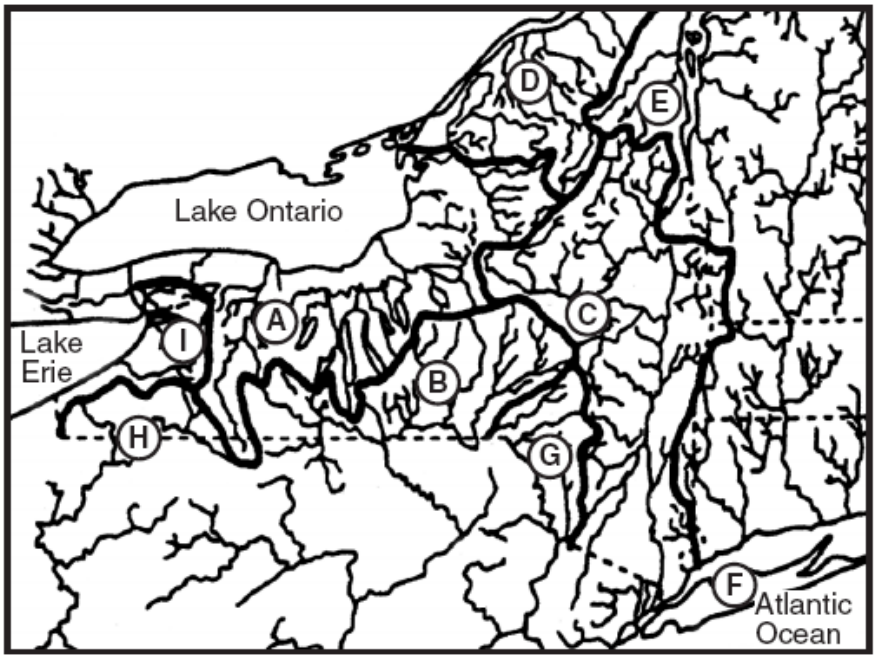


____ 1. At which two locations is the rate of erosion greater than the rate of deposition?
(1) A and B (3) C and D
(2) B and C (4) D and A

____ 2. What are the largest particles that this stream can transport when its velocity is 200 centimeters per second?
(1) silt (3) pebbles
(2) sand (4) cobbles

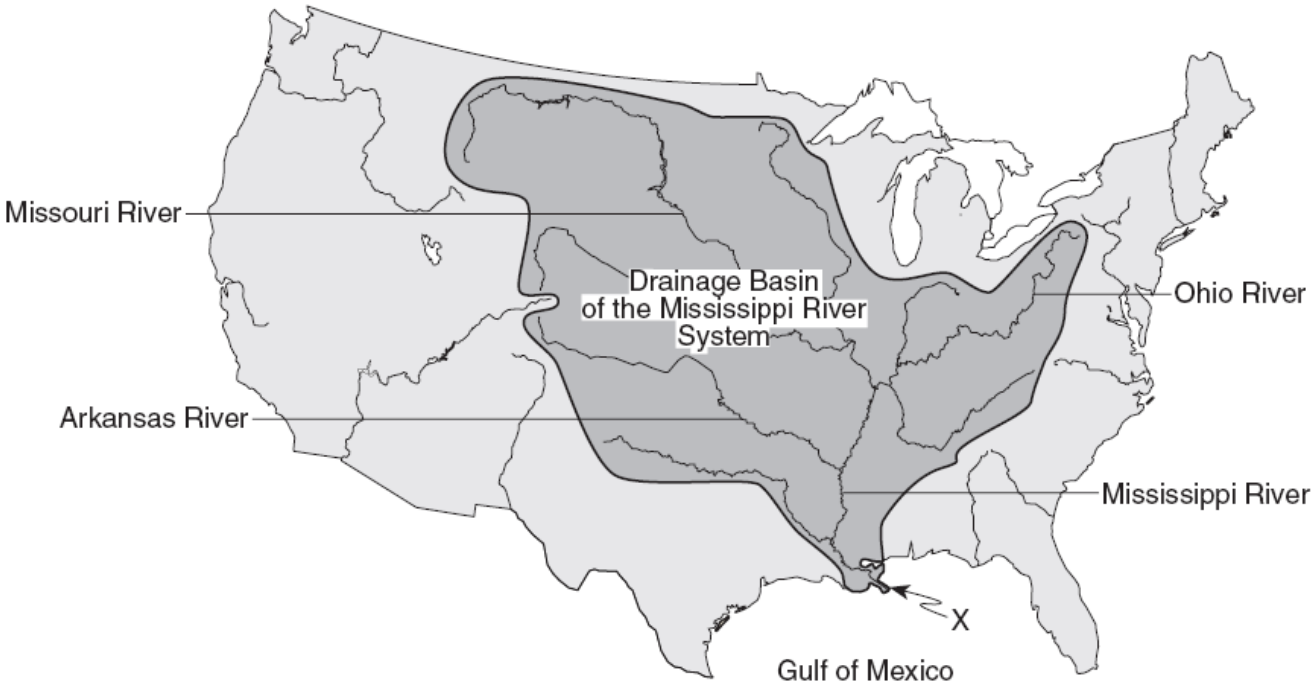
____ 3. A decrease in the velocity of this stream will most likely cause an increase in
(1) the amount of sediment carried by the stream
(2) the size of the particles carried by the stream
(3) deposition within the stream channel
(4) abrasion of the stream channel

____ 4. The map below shows major streams in the New York State area. The bold lines mark off sections *A* through *I* within New York State.



The best title for the map would be
(1) "Tectonic Plate Boundaries in New York State"
(2) "Bedrock Geology Locations of New York State"
(3) "Landscape Regions of New York State"
(4) "Watershed Areas of New York State"

Base your answers to questions 5 through 9 on the map below, which shows the drainage basin of the Mississippi River system. Several rivers that flow into the Mississippi River are labeled. The arrow at location *X* shows where the Mississippi River enters the Gulf of Mexico.



____ 5. The entire land area drained by the Mississippi River system is referred to as a
(1) levee (2) meander belt (3) watershed (4) floodplain

____ 6. Sediments deposited at location *X* by the Mississippi River most likely have which characteristics?
(1) angular fragments arranged as mixtures
(2) rock particles arranged in sorted beds
(3) rocks with parallel scratches and grooves
(4) high-density minerals with hexagonal crystals

____ 7. The structure formed by the deposition of sediments at location *X* is best described as a
(1) moraine (2) delta (3) tributary (4) drumlin

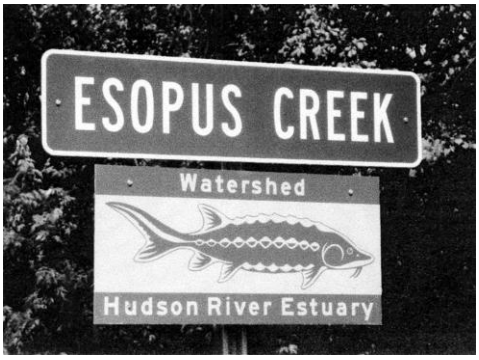
____ 8. Most New York State sandstone bedrock was formed
(1) in Earth's interior where temperatures exceeded the melting point of quartz
(2) on Earth's surface from the cooling of molten lava
(3) in a delta from sand grains deposited, buried, and cemented together by minerals
(4) in a desert when heat and metamorphic pressure caused quartz crystals to fuse together

____ 9. The diagrams below show gradual stages 1, 2, and 3 in the development of a river delta where a river enters an ocean.

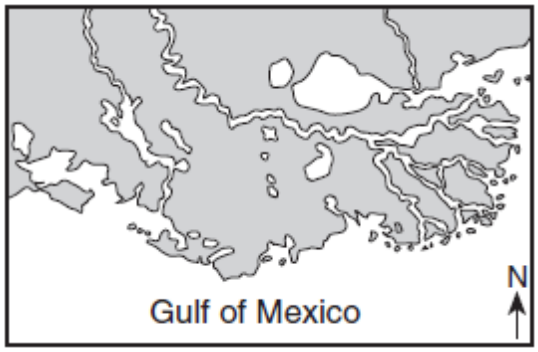
Stage 1 Stage 2 Stage 3

Which statement best explains why the river delta is developing at this site?
(1) The rate of deposition is less than the rate of erosion.
(2) The rate of deposition is greater than the rate of erosion.
(3) Sea level is slowly falling.
(4) Sea level is slowly rising.

____ 10. The photograph to the right shows a sign near the Esopus Creek in Kingston, New York. The main purpose of the word "watershed" on this sign is to communicate that the Esopus Creek
(1) is a tributary of the Hudson River
(2) is a flood hazard where it flows into the Hudson River
(3) forms a delta in the Hudson River
(4) contains ancient fish fossils



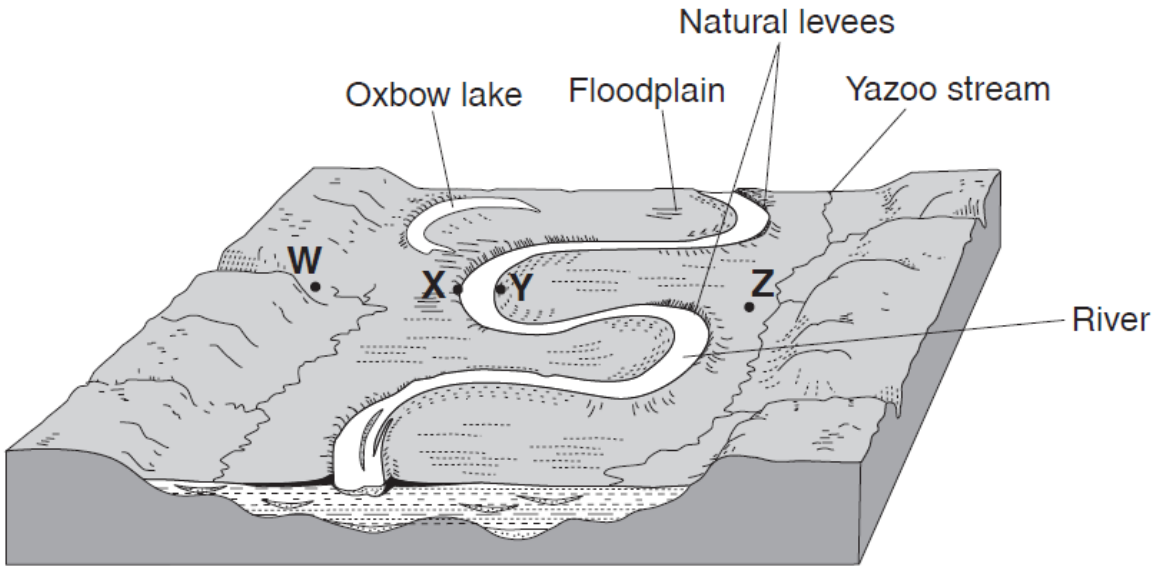
____ 11. The map below shows the large delta that formed as the Mississippi River emptied into the Gulf of Mexico.



Which process was primarily responsible for the formation of the delta?

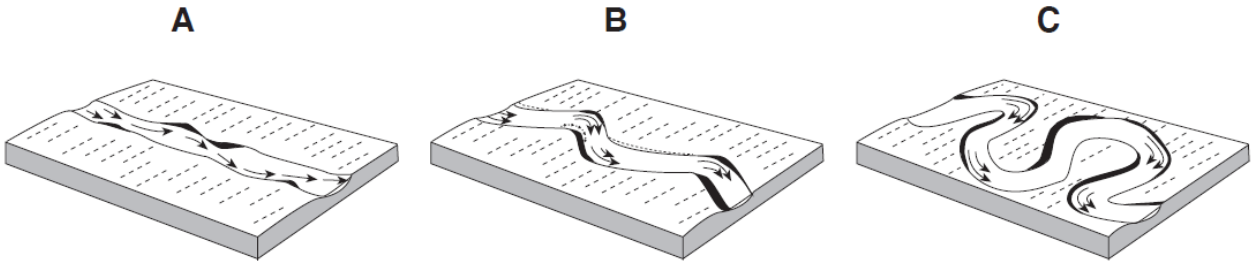
(1) glacial erosion
(2) cementation of sediment
(3) deposition of sediment
(4) mass movement

Base your answers to questions 12 through 16 on the diagram below, and your knowledge of Earth science. The diagram represents the landscape features associated with a meandering river. Letters W, X, Y, and Z represent locations on the floodplain.



____ 12. The diagram below represents stages in the formation of this meandering river. Which sequence best represents the usual changes over time?

(1) A →B →C (2) A →C →B (3) C →A →B (4) C →B →A



____ 13. At which location is erosion greatest? (1) W (2) X (3) Y (4) Z

____ 14. The natural levees are ridges of sediment that slope away from the riverbank toward the floodplain. Which process most likely formed these levees?

(1) weathering of the soil on the riverbanks
(2) erosion on the inside curves of the meanders
(3) deposition by the yazoo stream
(4) deposition when the river overflowed its banks

____ 15. During transport by this river, a sediment particle will most likely become

(1) more rounded (2) heavier (3) more dense (4) larger

____ 16. Which change would most likely increase the velocity of the river?

(1) a decrease in the slope of the river
(2) an increase in the river's discharge
(3) a decrease in the temperature of the river
(4) an increase in the width of the river

Introduction:

It is often said that steams have a life of their own. In a way, this is true. Today you will design your own stream channel. First you will make predictions on what will happen to the stream channel and then you will be adding water to test your hypothesis.

Materials
- ✓ Pencil
- ✓ Sand
- ✓ Stream table
- ✓ 2 buckets
- ✓ water
- ✓ 2 hoses
- ✓ elevation blocks

Objective:

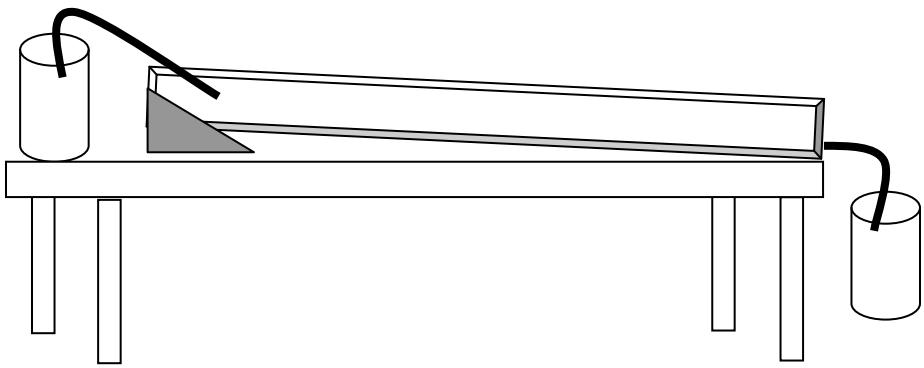
- Observe the formation and destruction of features in a stream

Procedure:

1. Go to the stream table as directed by your teacher
2. Make sure the sand does not go past the "NO SAND" line on the table
3. Place the stream table is at the lowest angle on your elevation blocks.
4. Create a stream channel that includes at least 2 meanders.
5. In the box below, draw the stream as it appears now (before the water is added).

6. Predict what features will form and or the changes that will occur to your stream once you allow the water to flow. Draw your predicted "new" stream below.

7. Have both diagrams above checked by your teacher.
8. Make sure the drainage hose is in the buck on the floor.
9. Place the other hose into the bucket of water on the table. Leaving one end in the water, place your finger over the opening on the other end. Carefully place the hose in the table and remove your finger. This should allow the water start to flow.



Do not move the hose once you have begun.

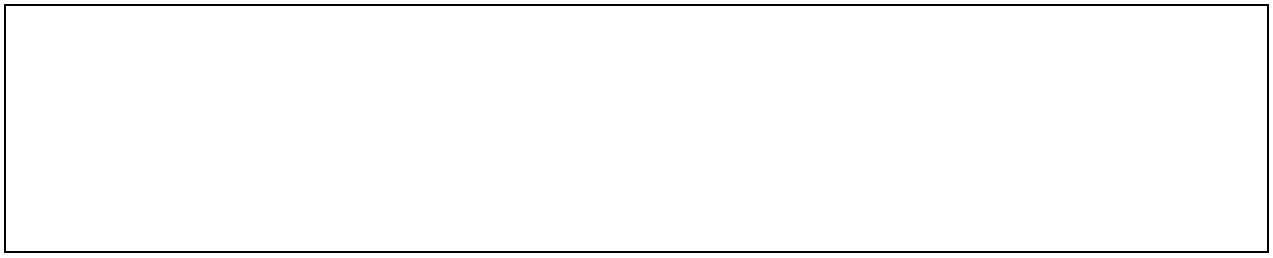
10. Place a couple pieces of paper (from the hole punch) into the stream. In the meanders, where is the stream moving the fastest? _____

11. Where does most of the erosion occur as the water goes around the meander?

_____

_____

12. Allow the stream to continue until you can make 5 distinct observations. Draw and describe them below.



13. Change the slope of the stream table and rearrange some of the sand to create a barricade. Just be careful not to have the water flow over the sides of the stream table.

14. Make observations below.

_____

_____

_____

_____

15. What happened to the velocity of the stream when you increased the slope?

_____

16. What is the process that takes place on the outside of a meander? _____

17. What is the process that takes place on the inside of a meander? _____

18. What process takes place as the running water (stream) reaches the small pool of water (pond) at the end of the table? _____

19. Why do streams in New York State tend to have more water in early spring than they do in summer? _____

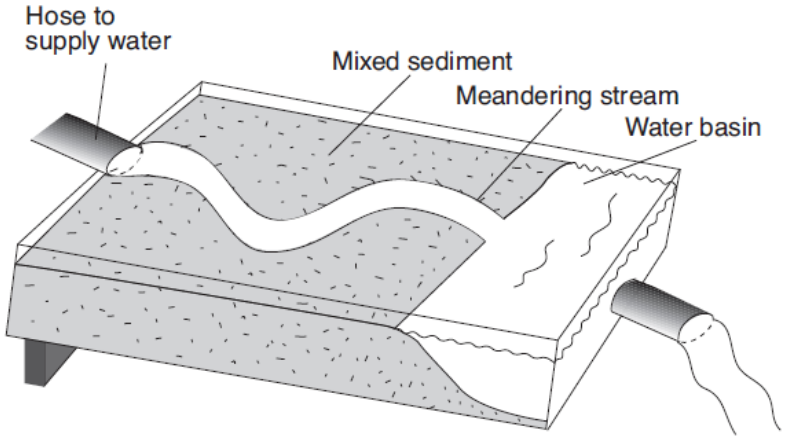
20. Where does the water in a creek come from in the summer when there has been little to no rain? _____

21. What happens to the size and shape of sediments as they are moved along a stream bed? _____

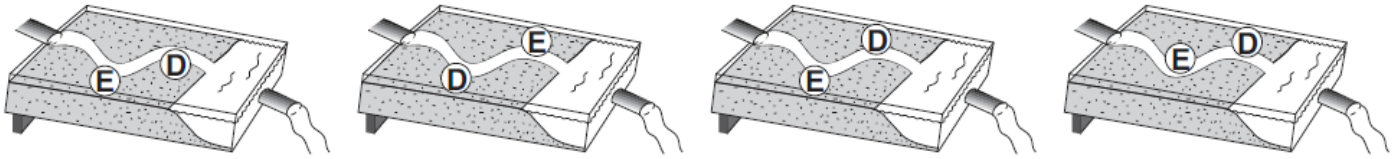
_____

Regents Questions:

Base your answers to questions 1 through 3 on the diagram below, which shows a model used to investigate the erosional-depositional system of a stream. The model was tilted to create a gentle slope, and a hose supplied water to form the meandering stream shown.

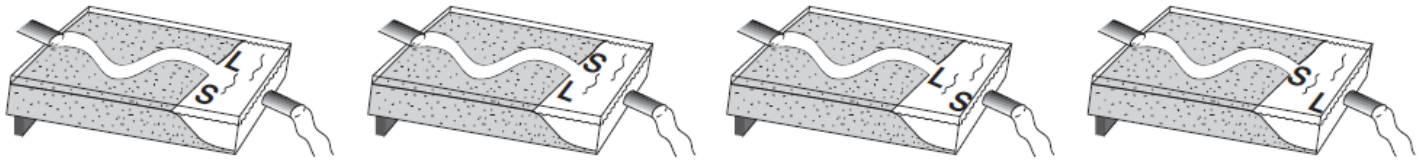


____ 1. Which diagram best represents where erosion, E, and deposition, D, are most likely occurring along the curves of the meandering stream?



(1) (2) (3) (4)

____ 2. Which diagram best represents the arrangement of large, L, and small, S, sediment deposited as the stream enters the water basin?



(1) (2) (3) (4)

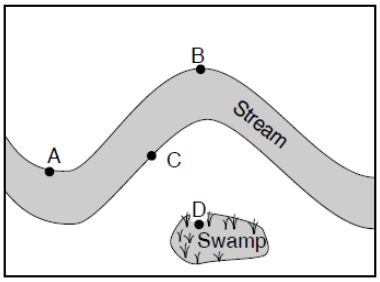
____ 3. How can the model be changed to increase the amount of sediment transported by the stream?

(1) decrease the temperature of the sediment
(2) decrease the slope
(3) increase the size of the sediment
(4) increase the rate of the water flow

____ 4. An environmental scientist needs to prepare a report on the potential effects that a proposed surface mine in New York State will have on the watershed where the mine will be located. In which reference materials will the scientist find the most useful data with which to determine the watershed's boundaries?

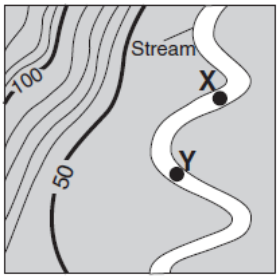
(1) topographic maps
(2) tectonic plate maps
(3) geologic time scales
(4) planetary wind maps

____ 5. The map below shows the area surrounding a meandering stream.

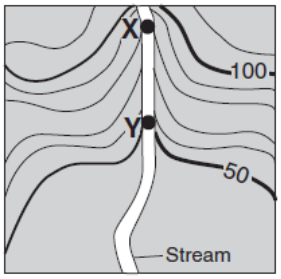


At which point is erosion greatest?
(1) A
(2) B
(3) C
(4) D

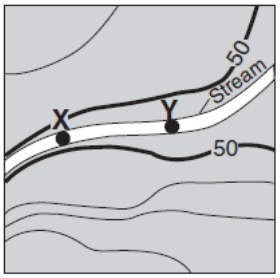
____ 6. The four streams shown on the topographic maps below have the same volume between X and Y. The distance from X to Y is also the same. All the maps are drawn to the same scale and have the same contour interval. Which map shows the stream with the greatest velocity between points X and Y?



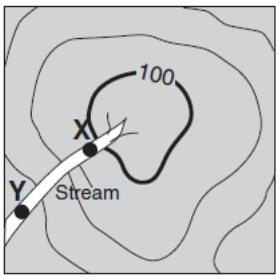
(1)



(2)



(3)



(4)

____ 7. Which river is a tributary branch of the Hudson River?
(1) Delaware River (3) Mohawk River
(2) Susquehanna River (4) Genesee River

____ 8. The table below shows the rate of erosion and the rate of deposition at four stream locations.

Location	Rate of Erosion (tons/year)	Rate of Deposition (tons/year)
A	3.00	3.25
B	4.00	4.00
C	4.50	4.65
D	5.60	5.20

A state of dynamic equilibrium exists at location
(1) A (2) B (3) C (4) D

____ 9. Two streams begin at the same elevation and have equal volumes. Which statement best explains why one stream could be flowing faster than the other stream?
(1) The faster stream contains more dissolved minerals.
(2) The faster stream has a much steeper gradient.
(3) The streams are flowing in different directions.
(4) The faster stream has a temperature of 10°C, and the slower stream has a temperature of 20°C.

Mini Lesson 3: Glaciers

Glaciers are large, very slow moving ice. They form when more snow falls in the winter than can melt in the summer. They form in high latitudes and high elevations. Gravity causes glaciers to flow down a valley or spread out over a continent. They push, drag and carry sediment from very small to ***boulder*** size. As they move they create features such as striations (scratches) on the rock and parallel groves in the bedrock. As the ice melts, sediment is dropped out (deposited) and is *unsorted*. *Erratics* are left behind. These are rocks that do not match the size and type of other rocks in the same area. The rocks may be partially rounded.

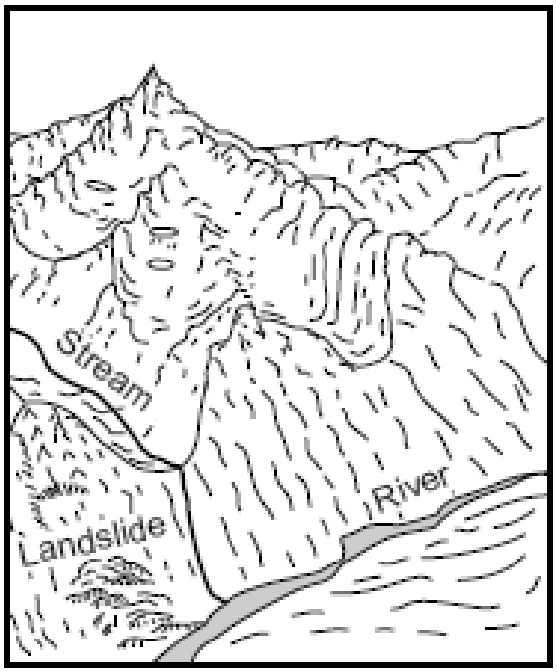
Need to know:

1. What are glaciers? _____
2. How do glaciers form? _____

   _____
3. Name two locations glaciers form. _____ & _____
4. What cause glaciers to move? _____
5. How do glaciers move sediment? _____ , _____ and _____
6. Name two features left behind by glaciers. _____ & _____
7. Describe the sediment left by a glacier. _____
8. What are erratic? _____

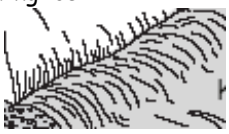
Valley Glacier Features

- As the valley glacier moves down the mountain it cuts out the sides and forms ***"U" shaped valleys.*** Using a green color pencil, trace the two "U" shape in the valleys.
- They can transport any size sediments, even ***boulders***.
- Sediments deposited from a valley glacier are also ***unsorted***.
- The rocks have ***striations*** (scratches) are caused by rubbing and grinding as the glacier moves.

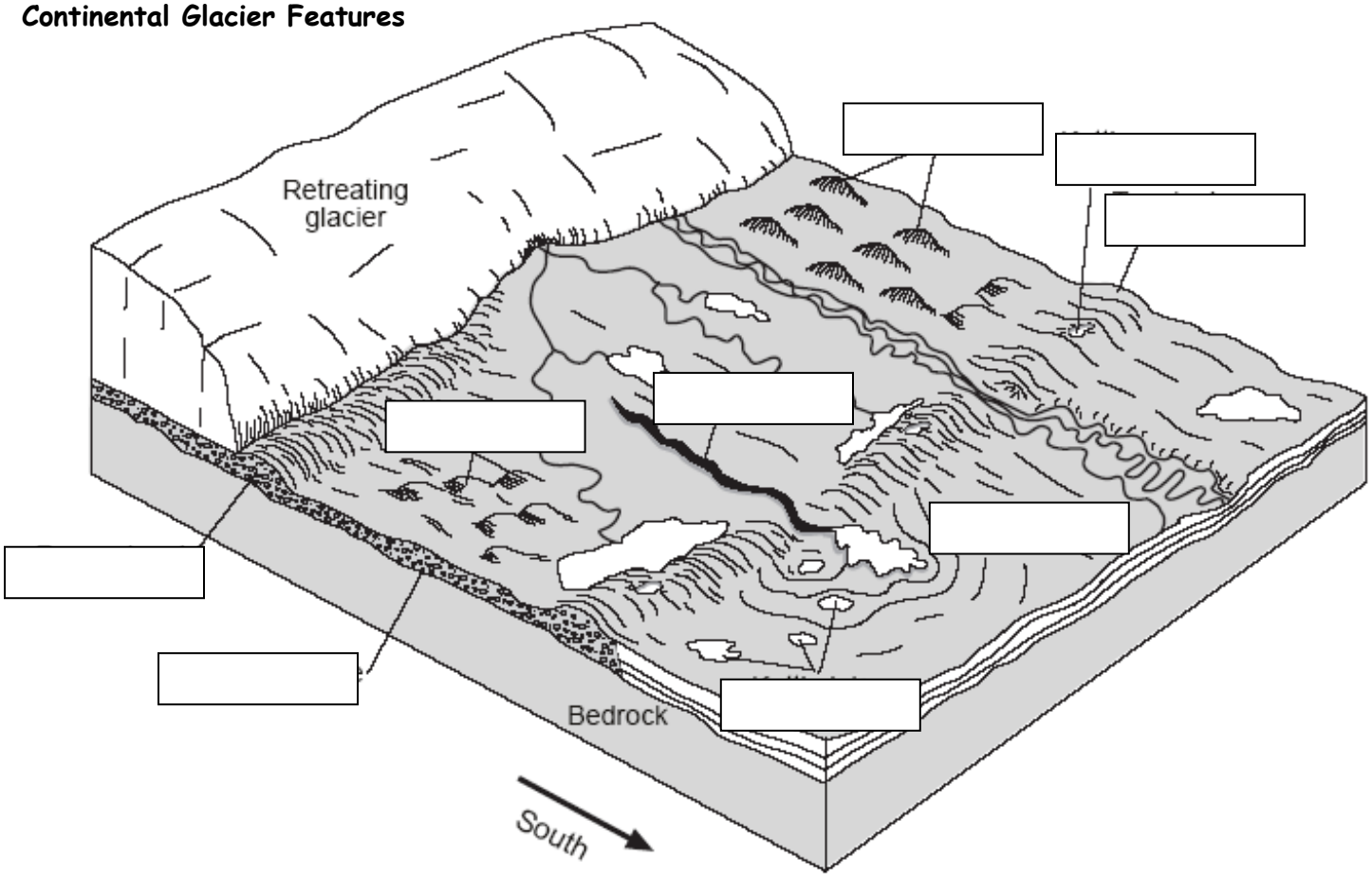


Show what you know: **Glaciers**

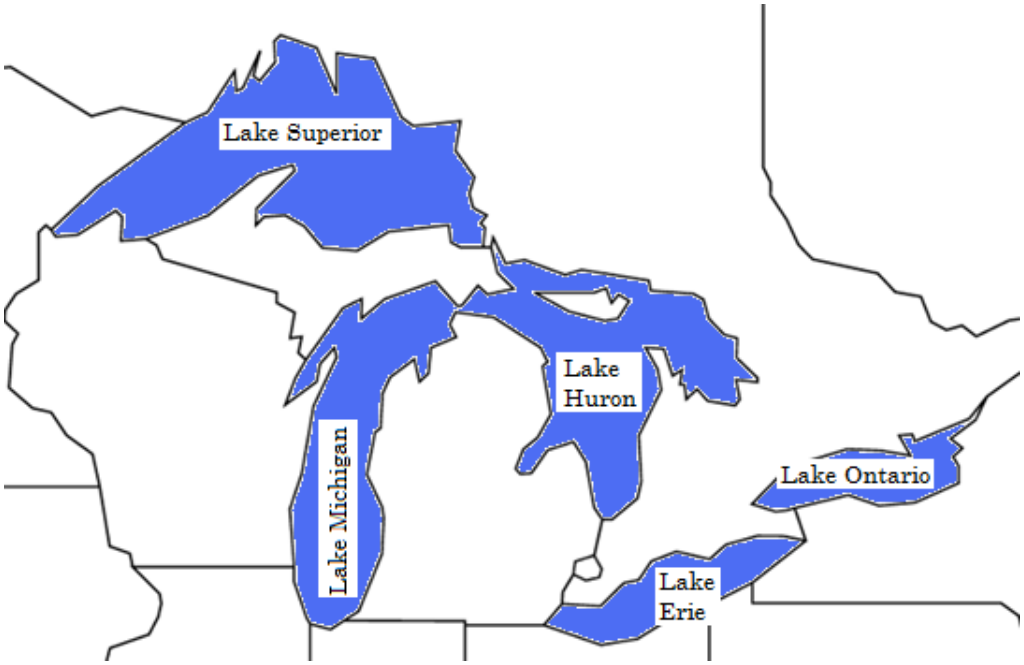
Below is a list of features and descriptions left by a glacier. Match up the features and images below and label the diagram on page 9.

Feature	Description	Image
moraine	large deposits of glacial till (unsorted sediment) that forms when the glacier has stalled or retreated (melted).	
terminal moraine	large ridge of glacial till marking the farthest advancement of the glacier * horizontal rock layers are located immediately next to unsorted sediment	
recessional moraine	mixture of sand, gravel and rock that is deposited as the ice front melts * it is found directly in front of the melting glacier * *Glaciers do not actually move backward as the word retreat implies.*	Melting ice 
ground moraine	mixture of sand, gravel and rock that is deposited as the ice retreats * a flat area, underground, with unsorted sediments	
esker	long narrow ridge of coarse gravel deposited by a stream flowing in a narrow ice tunnel under the glacier	
drumlin	a glacial hill that is shaped like the back of a spoon by the ice. They indicate the direction of glacial movement, toward the gentle slope	
kames	irregularly shaped hills composed of sorted sand and gravel. They are formed from the melt water of the glacier.	
outwash plain	forms from the meltwater of the glacier. It has horizontal layers of sorted glacial material and is found in front of the glacier.	
kettle hole kettle lake	occurs when a large piece of a glacier drops off the front and becomes partially buried. If the hole fills with water it is a Kettle lake * Write "kettle lake" in two places on the diagram	

Continental Glacier Features

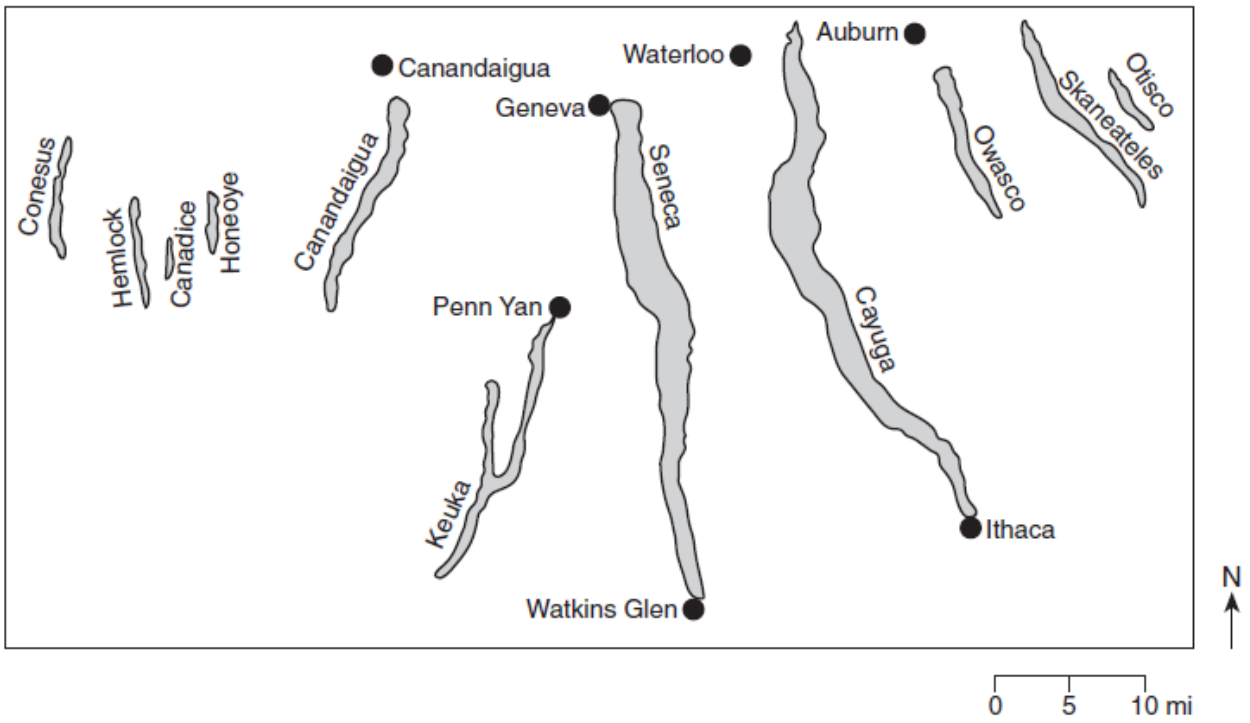


The Great Lakes formed at the end of the ice age, approximately 10,000 years ago. Glaciers carved out the bedrock and glacial melt waters filled the basins. The lakes contain approximately 20 % of the world's fresh surface water.

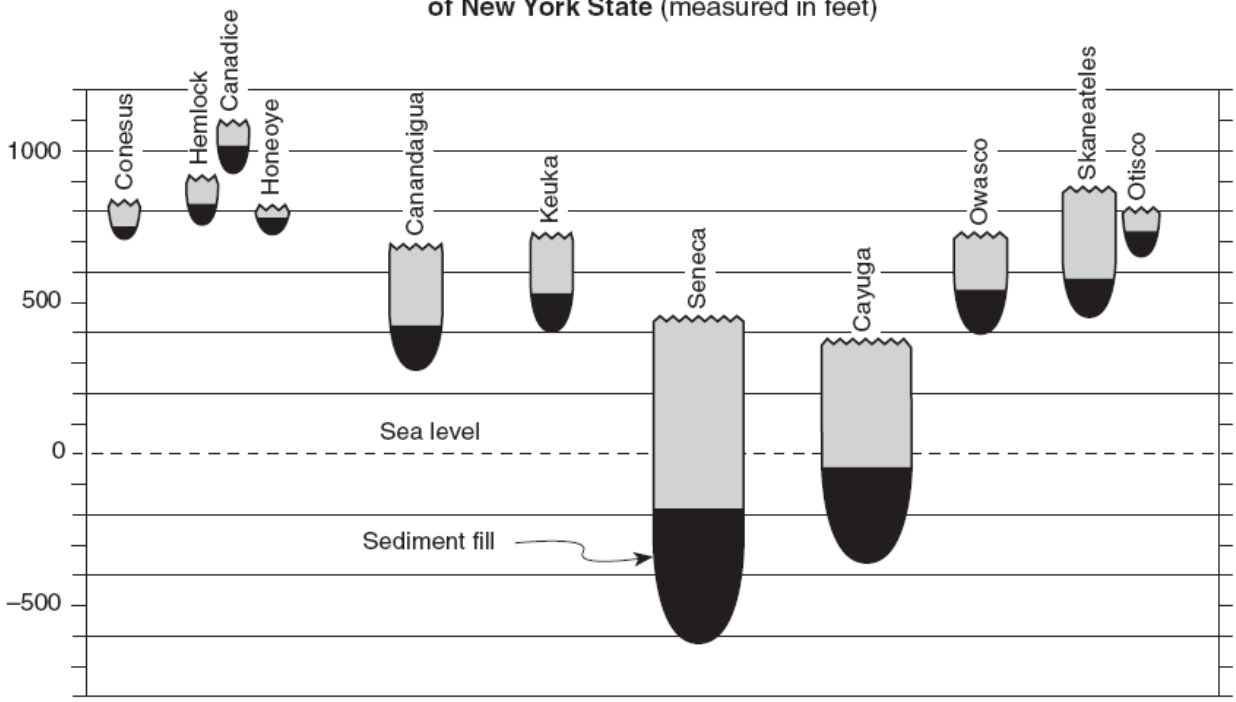


The Finger Lakes were once pre-existing stream valleys or lakes that were modified by glaciers. When the ice retreated deposits left behind dammed the steam valleys and melt water filled them. The orientation of lakes show glacier movement through the former stream valleys.

Finger Lakes Region of New York State



Elevation and Depth of the Finger Lakes of New York State (measured in feet)



Base your answers to questions 1 through 4 on the map and cross section of the Finger Lakes Region shown on page 26 and on your knowledge of Earth science.

1. According to the cross section, how thick from top to bottom is the sediment fill in Seneca Lake? _____

2. State *one* possible explanation for the north-south orientation of the Finger Lakes.

_____

_____

_____

3. During some winters, a few of the Finger Lakes remain unfrozen even though the land around the lakes is frozen. Explain how the specific heat of water can cause these lakes to remain unfrozen.

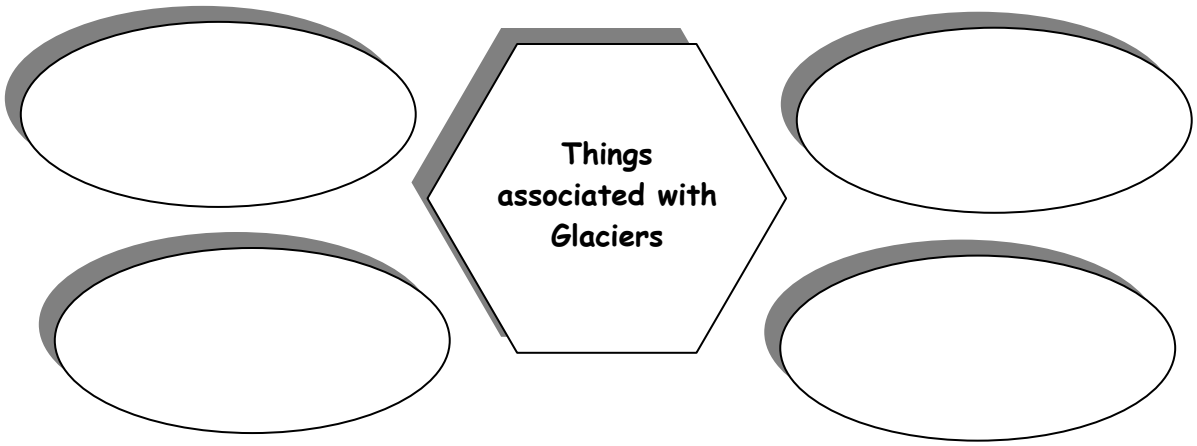
_____

_____

_____

4. Identify *two* processes that normally occur to form the type of surface bedrock found in the Finger Lakes Region. _____ and _____

Fill in the four ovals below with key words that are associated with glaciers. Hint, look at the bold and italicized words on page 7.



Regents Questions:

____ 1. Which statement identifies a result of glaciation that has had a positive effect on the economy of New York State?
(1) Large amounts of oil and natural gas were formed.
(2) The number of usable water reservoirs was reduced.
(3) Many deposits of sand and gravel were formed.
(4) Deposits of fertile soil were removed.

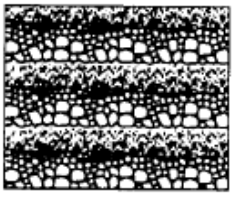
____ 2. Large igneous boulders have been found on surface sedimentary bedrock in Syracuse, New York. Which statement best explains the presence of these boulders?
(1) Sedimentary bedrock is composed of igneous boulders.
(2) Boulders were transported to the area by ice.
(3) The area has had recent volcanic activity.
(4) The area was once part of a large mountain range.

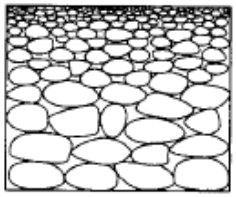
____ 3. Which rock material was most likely transported to its present location by a glacier?
(1) rounded sand grains found in a river delta
(2) rounded grains found in a sand dune
(3) residual soil found on a flat plain
(4) unsorted loose gravel found in hills

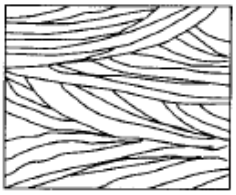
____ 4. The striations indicate that the movement of glacial ice was toward the -
(1) northeast and northwest
(2) southeast and northwest
(3) northeast and southwest
(4) southeast and southwest

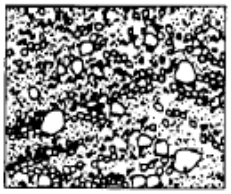
____ 5. The Harbor Hill Moraine and the Ronkonkoma Moraine are believed to have formed during the
(1) Jurassic Period
(2) Pleistocene Epoch
(3) Cambrian Period
(4) Pennsylvanian Epoch

____ 6. Which cross section best represents the sediment that was transported and deposited by this glacier?


(1)

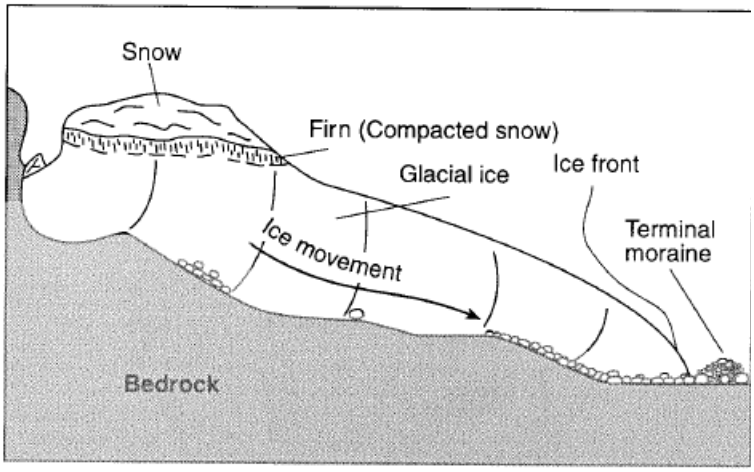

(2)


(3)


(4)

____ 7. The velocity of the ice movement is primarily controlled by the
(1) Amount of sediment at the terminal moraine
(2) Size of the sediment transported by the glacier
(3) Slope of the bedrock surface
(4) Length of the glacier

Base your answers to questions 8 through 10 on the diagram to the right. The diagram represents a profile of a mountain glacier in the northern United States.



____ 8. The downhill movement of mountain glaciers such as the one shown in the diagram is primarily caused by
(1) evaporation of ice directly from the glacier
(2) the force of gravity pulling on the glacier
(3) snow blowing across the top of the glacier
(4) water flowing over the glacier

____ 9. If the climate warms, causing the glacier to melt away, the region that the glacier formerly occupied will be a
(1) U - shaped valley with polished bedrock
(2) V - shaped valley with jagged bedrock
(3) Flat plain with bedrock that has been metamorphosed
(4) Deep ocean trench with bedrock that has been melted and cooled

____ 10. Over a period of years, this glacier gains more snow mass than it loses. What will be the most likely result?
(1) The glacier will decrease in size, and the ice front will retreat.
(2) The glacier will decrease in size, and the ice front will advance.
(3) The glacier will increase in size, and the ice front will retreat.
(4) The glacier will increase in size, and the ice front will advance.

____ 11. Observations of which feature would be most useful in determining the thickness of the ice sheet?
(1) grooved bedrock near the top of Bear Mountain
(2) glacial soils in southern Connecticut
(3) glacial boulders at the bottom of Long Island Sound
(4) scratches on loose rock at the mouth of the Hudson River

____ 12. Because of glaciation, New York State presently has soils that are best described as
(1) deep and residual
(2) unchanged by glaciation
(3) rich in gemstone minerals
(4) thin and rocky

____ 13. The bedrock at a certain location is deeply scratched, and in some places is covered by a layer of unsorted sediment. Which erosional agent was probably responsible for these features?

(1) ocean waves (2) running water (3) wind (4) glaciers

____ 14. How were the striations made?

(1) Frost action cracked the bedrock during the ice age.
(2) Rocks at the bottom of the glaciers were dragged over the bedrock.
(3) Particles carried by winds scratched the bedrock during the ice age.
(4) Particles carried by glacial melt water eroded the bedrock.

____ 15. Which statement provides the best evidence that New York State's Finger Lakes formed as a result of continental glaciation?

(1) The lake surfaces are above sea level.
(2) The lakes fill long, narrow U-shaped valleys.
(3) The lakes are partially filled with sorted beds of sediment.
(4) The lakes are surrounded by sharp, jagged peaks and ridges.

____ 16. What is the age of the most abundant surface bedrock in the Finger Lakes region of New York State?

(1) Cambrian (2) Pennsylvanian (3) Devonian (4) Permian

____ 17. On a field trip 40 kilometers east of the Finger Lakes, students observed a boulder of gneiss on the surface bedrock. This observation best supports the inference that the

(1) surface sedimentary bedrock was weathered to form a boulder of gneiss
(2) surface sedimentary bedrock melted and solidified to form a boulder of gneiss
(3) gneiss boulder was transported from its original area of formation
(4) gneiss boulder was formed from sediments that were compacted and cemented together

____ 18. The moraines are recognized as glacial deposits because they are composed of rock materials that are

(1) uniform in size and layered
(2) many different sizes and layered
(3) uniform in size and not layered
(4) many different sizes and not layered

Mini Lesson 4: Wind Erosion

Wind erosion is most common in arid (dry) climates, usually in deserts. Beaches too have wind erosion. The faster the wind blows, the larger the sediment it can carry. Once the wind begins to slow down larger particles settle out first. The main type of weathering is by abrasion. Features may be pitted flat faces and straight edges on the surface of the sediments. Surface features include dunes and sand blasted bedrock.

Need to know:

1. What kind of climate does wind erosion take place? _____
2. Where does most wind erosion take place? _____
3. Where is another place wind erosion may take place? _____
4. Describe how the velocity of the wind affects what sediments are carries or deposited.

_____

_____

5. What is the main type of weathering that takes place? _____
6. Describe the features of the sediments. _____

_____

7. Describe two surface features sediments.

_____

Introduction:

Sand dunes are formed by a buildup of sand caused by wind. The wind picks up the loose sand and eventually drops it, sometimes into piles. Water helps to form the sand dunes by holding the particles of sand together.

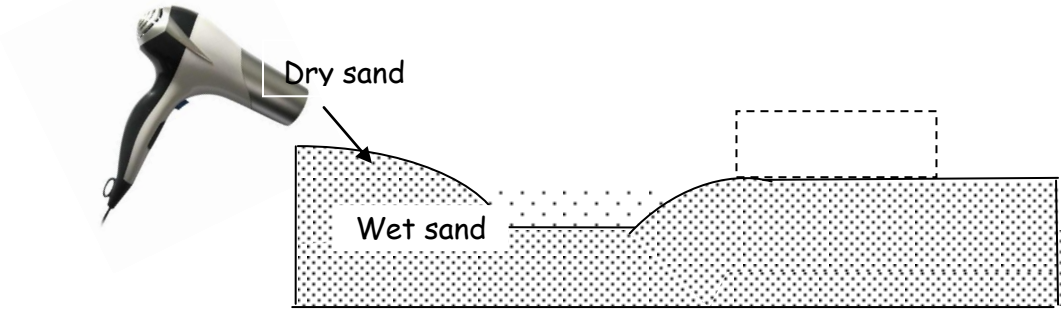
Materials
- ✓ Dry sand
- ✓ Wet sand
- ✓ Hair dryer
- ✓ Stream table

Objective:

- Observe a possible feature (sand dune) left by wind erosion

Procedure:

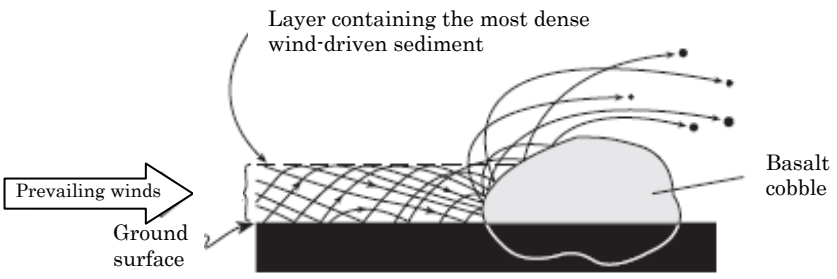
1. Using the wet sand, create a land feature as shown below
2. Place 3 to 4 inches of loose dry sand in the low area of the wet sand
3. Use the hair dryer to gently blow the sand across the land feature.
4. In the dashed box provided in the diagram below, draw the result of the sand being blown across the land feature.



Regents questions

____ 1. The particles in a sand dune deposit are small, very well sorted and have surface pits that give them a frosted appearance. This deposit most likely was transported by
(1) gravity (2) wind (2) glacial ice (4) ocean currents

____ 2. The cross section below shows the movement of wind-driven sand particles that strike a partly exposed basalt cobble located at the surface of a windy desert. Which cross section to the right best represents the appearance of this cobble after many years of exposure to the wind-driven sand?



Quick Review:

Agent of Erosion	Surface Feature Formed
Waves	Beach, sandbars, barrier islands
Wind	Loss of topsoil, dunes
Glacier	U-shaped valley, moraines, drumlins
Running water (streams)	V-shaped valley, deltas, meanders
Mass movement	Landslides, slumps, mass movement

Regents Questions:

____ 1. The diagram to the right shows a sedimentary rock sample. Which agent of erosion was most likely responsible for shaping the particles forming this rock?

(1) mass movement (3) glacial ice
(2) wind (4) running water

____ 2. Where is the most deposition likely to occur?
(1) on the side of a sand dune facing the wind
(2) at the mouth of a river, where it enters an ocean
(3) at a site where glacial ice scrapes bedrock
(4) at the top of a steep slope in a streambed

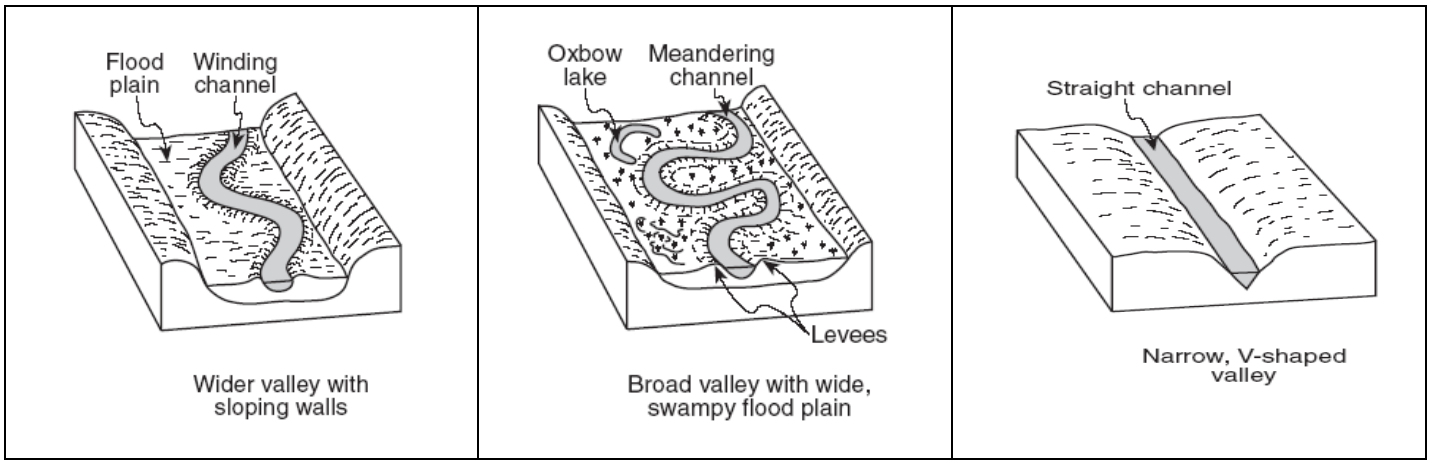
____ 3. The occurrence of parallel scratches on bedrock in a U-shaped valley indicates that the area has most likely been eroded by
(1) a glacier (2) waves (3) a stream (4) wind

____ 4. A stream flowing at a velocity of 75 centimeters per second can transport
(1) clay, only (3) pebbles, sand, silt, and clay, only
(2) pebbles, only (4) boulders, cobbles, pebbles, sand, silt, and clay

5. Match the agent of erosion that corresponds to the identifying characteristic surface features described below.

Agent of Erosion	Surface Feature Formed
_____ Glaciers	A. Beach, sandbars, barrier islands
_____ Mass movement	B. Loss of topsoil, dunes
_____ Running water (streams)	C. U-shaped valley, moraines, drumlins
_____ Waves	D. V-shaped valley, deltas, meanders
_____ Wind	E. Landslides, slumps

Stages in a Stream Development



Formation of an Oxbow Lake