Mr. Brown's

SCIENCE LABS

Regents Cluster Practice

Weathering & Erosion

with Human Impact

5 Clusters	25 Questions	Regents-Aligned

Directions: Use your knowledge of Earth and Space Sciences to answer all questions in this practice packet. Before you begin, you must have access to the **2024 Edition Reference Tables for Earth and Space Sciences (ESRT)**. You may need these reference tables to answer some of the questions. Record your answers directly in the spaces provided. Each question is worth **1 point**. Completing the data table is worth **4 points**. The final grade is calculated at the end. Note that diagrams are not drawn to scale unless otherwise noted.

Name: ________________________________	Period: ______ Date: _____________

CLUSTER 1 • Questions 1–5

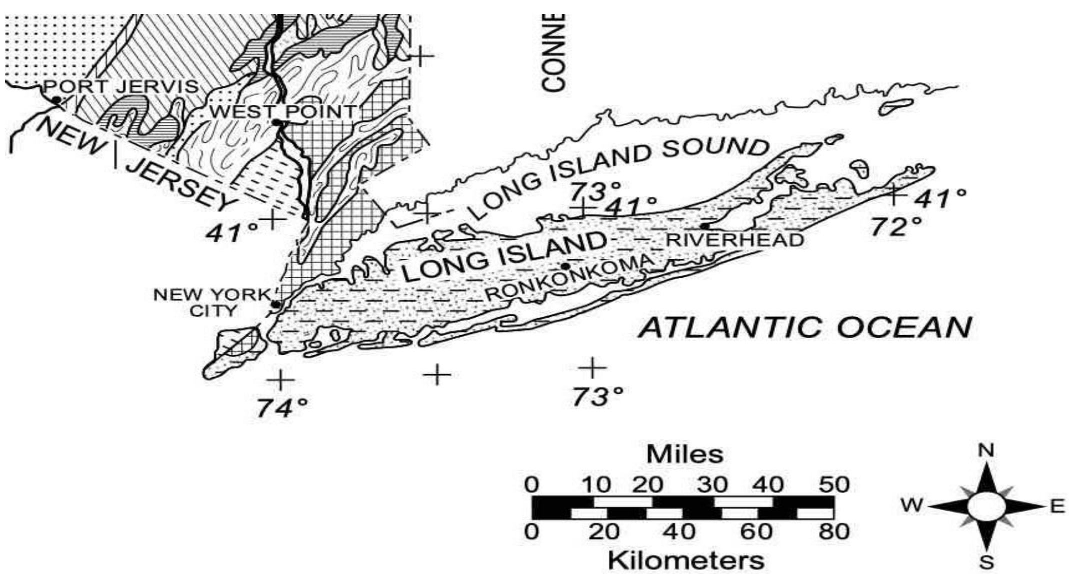
Base your answers to questions 1 through 5 on the information below and on your knowledge of Earth and Space Sciences. Some questions may require the use of the 2024 Edition Reference Tables for Earth and Space Sciences.

Coastal Erosion on Long Island's South Shore

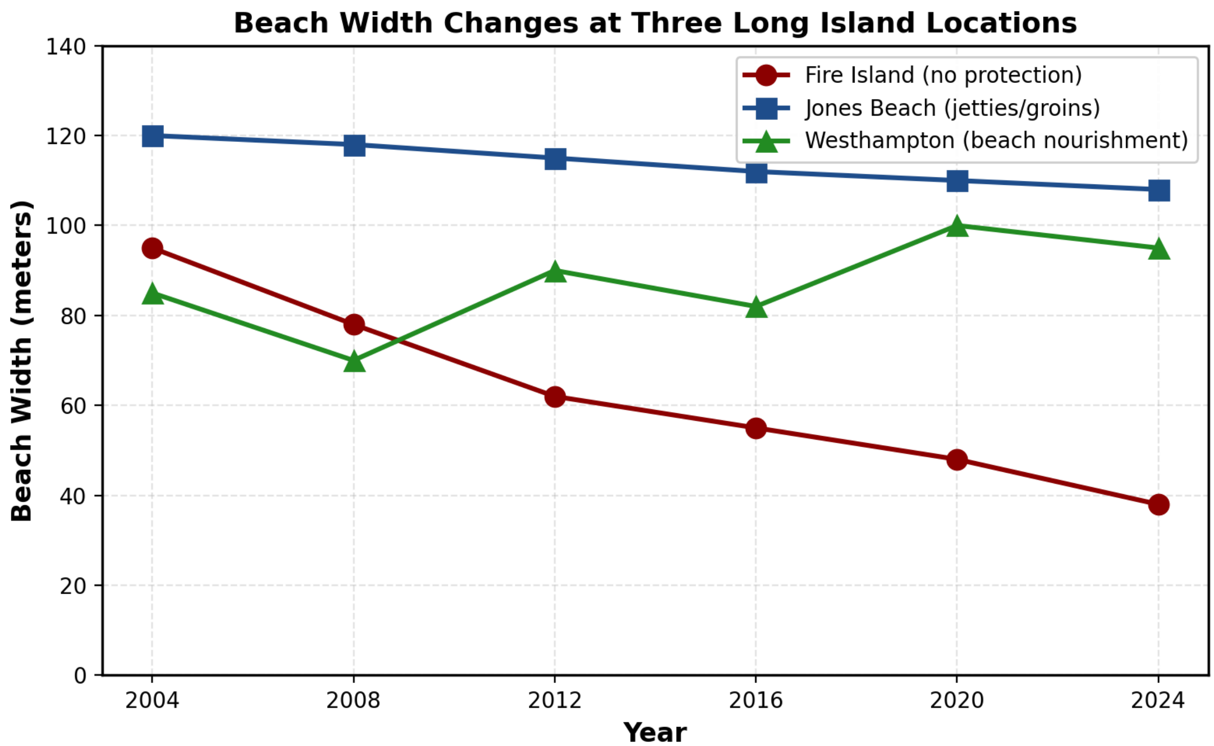
The south shore of Long Island, New York, is made up of a series of barrier islands, including Fire Island, Jones Beach Island, and Westhampton Beach. These barrier islands are composed of unconsolidated sands and gravels deposited during the most recent continental glaciation. Because these sediments are loose and poorly cemented, they are highly vulnerable to wave action, longshore currents, and coastal storms such as hurricanes and nor'easters. Each year, waves remove material from the ocean-facing side of the barriers and deposit it in other locations, causing the shoreline to migrate westward.

To protect homes, roads, and infrastructure, several human engineering solutions have been used along the south shore. **Jetties** and **groins** are hard structures built perpendicular to the beach that trap sand moving along the shore. **Seawalls** are vertical barriers that reflect wave energy. **Beach nourishment** is a soft engineering solution in which sand is pumped from offshore sources and placed on eroding beaches to rebuild them. Each method has trade-offs in terms of cost, effectiveness, and impact on nearby ecosystems.

Map of Long Island, New York



Beach Width Measurements at Three South Shore Locations (2004–2024)



1 Complete each of the three statements below to correctly describe factors responsible for coastal erosion on Long Island by placing an X in the box to indicate which phrase correctly completes each statement. ***[1]***

Statement 1:

The unconsolidated sands of Long Island's barrier islands are highly erodible because they are

☐ poorly cemented sediments deposited by continental glaciers
☐ solid crystalline bedrock formed by regional metamorphism

Statement 2:

Waves move sand along the shoreline in a process called longshore transport that causes the

☐ shoreline to migrate westward along the south shore
☐ barrier islands to grow larger in the direction of the open ocean

Statement 3:

A primary atmospheric event that accelerates coastal erosion on Long Island is

☐ hurricanes and nor'easters producing large storm waves
☐ summer high pressure systems producing calm winds

2 A student collected samples from three Long Island beach locations and recorded the observations below. ***[1]***

A	Sediments were well-sorted, rounded grains of quartz sand
B	Sediments contained many different sizes including cobbles and boulders
C	Sediments were dense and dark in color with angular edges
D	Sediments showed rounding and smooth surfaces consistent with wave abrasion
E	Sediments were poorly sorted and contained clay-sized particles
F	Sediments contained large amounts of crushed shells and marine fragments

Which set of observations correctly identifies sediments that have experienced the greatest amount of weathering and erosion by ocean waves?

(1) Observations A, D, and F
(2) Observations B, C, and E
(3) Observations A, C, and E
(4) Observations B, D, and F

3 A student makes a claim that beach nourishment is a more effective long-term design solution than building jetties for reducing coastal erosion on Long Island. Using the graph and reading, which statement provides the most correct evidence to support this claim?

(1) Beach nourishment at Westhampton maintained beach widths above 80 meters through 2024 without blocking longshore sand transport, while locations with no protection, like Fire Island, showed continuous loss of beach width.

(2) Jetties at Jones Beach increased beach width over the 20-year span while nourishment at Westhampton decreased beach width to less than 50 meters by 2024.

(3) Beach nourishment is cheaper than jetties and permanently stops all wave erosion at all times of the year regardless of storm activity.

(4) Jetties reflect all wave energy away from the coast, while beach nourishment causes the barrier islands to migrate eastward into deeper ocean water.

4 Using the graph data, rank the three Long Island locations below in order from greatest total loss of beach width to least total loss of beach width from 2004 to 2024. Justify your ranking using numerical evidence from the graph. ***[1]***

Greatest loss	1. ____________________________________
	2. ____________________________________
Least loss	3. ____________________________________

Justification:

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5 A student makes the following claim:

"Building more jetties along the entire south shore of Long Island will stop all beach erosion and will not affect beaches located west of the jetties."

Place a check mark (✓) in either the Support or Refute box below to indicate whether the given information supports or refutes the student's claim. Justify your response using evidence from the reading and graph. *[1]*

☐	**Support**
☐	**Refute**

Justification:

CLUSTER 2 • Questions 6–10

Base your answers to questions 6 through 10 on the information below and on your knowledge of Earth and Space Sciences. Some questions may require the use of the 2024 Edition Reference Tables for Earth and Space Sciences.

Differential Weathering in Letchworth Gorge

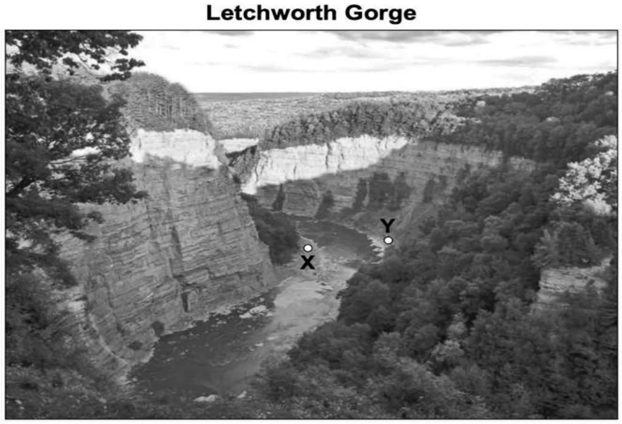
Letchworth State Park is located in western New York, southwest of Rochester, where the Genesee River has carved a deep gorge through Upper Devonian bedrock. The walls of the gorge contain alternating layers of **shale** and **sandstone**. Shale is a fine-grained sedimentary rock composed of compacted clay particles, while sandstone is made of cemented sand-sized grains of quartz. Because these two rock types have different compositions and physical properties, they weather and erode at different rates — a process known as **differential weathering**.

The photograph on the following page shows two locations in the gorge, labeled X and Y. Location X lies along the base of the gorge near the river. Location Y is on a steep, undercut cliff face along the upper gorge wall. The weaker shale layers erode more quickly than the resistant sandstone, producing overhangs that eventually collapse as **landslides** and **rockfalls**. This cliff retreat is the primary process by which the gorge widens over time. Hiking trails along the gorge must be carefully planned to avoid areas with unstable rock faces.

Letchworth Gorge — Locations X and Y

The photograph below shows the gorge in Letchworth State Park along the Genesee River. Two locations in the gorge are labeled *X* and *Y*.

Letchworth Gorge



Students in a class were tasked with identifying a new hiking route along the edge of the section of the Genesee River shown in the photo.

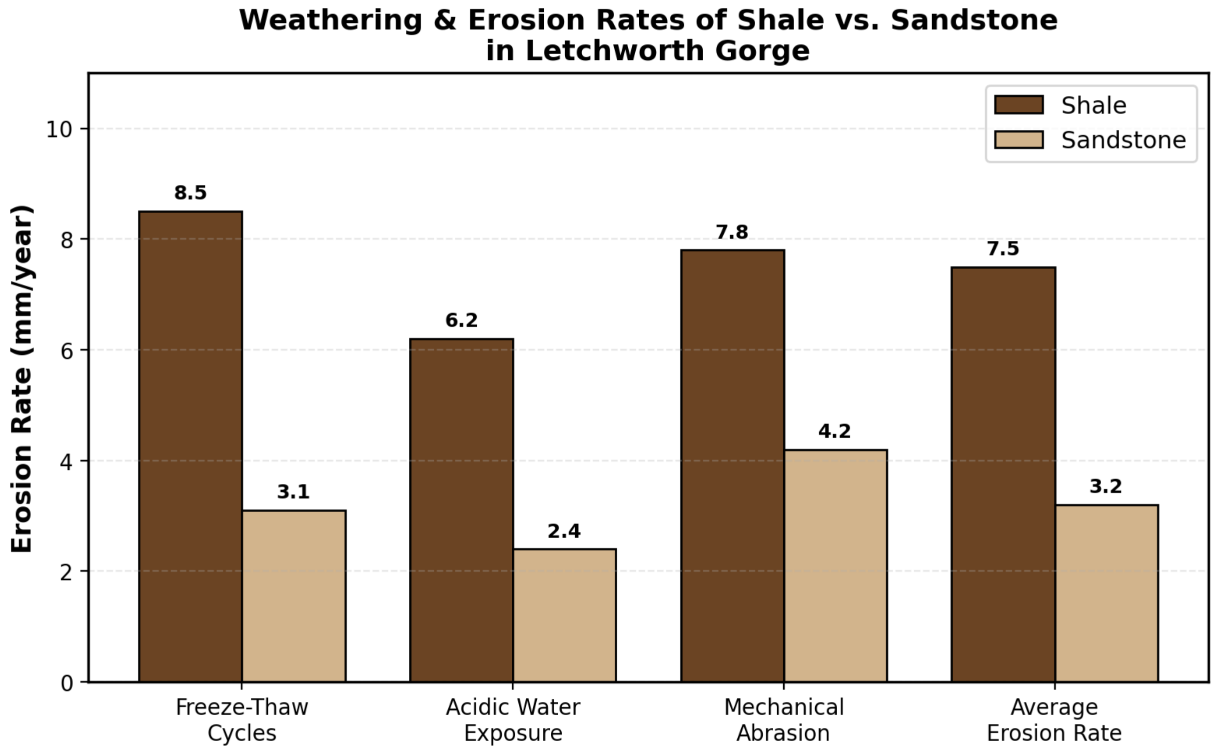
A student makes the claim below:

The safest route of the hiking trail should be near location __A__ because at __B__ there is a greater chance of weathering and erosion due to __C__, which increases the risk of __D__ along the trail.

Choices for:

A	B	C	D
X or Y	*X or Y*	wind *or* gravity	flooding *or* landslides

Weathering and Erosion Rates of Shale vs. Sandstone



6 Complete each of the three statements below by placing an X to correctly describe the factors responsible for differential weathering in Letchworth Gorge. ***[1]***

Statement 1:

Evidence from the graph shows that shale weathers faster than sandstone due to

☐ higher erosion rates caused by freeze-thaw cycles and mechanical abrasion
☐ lower rates of erosion produced by chemical reactions and ice wedging

Statement 2:

One property of shale that causes it to break down more quickly than sandstone is that

☐ shale has larger, more tightly cemented grains than sandstone
☐ shale is fine-grained and splits easily along bedding planes

Statement 3:

Differential weathering in the gorge produces a characteristic landform where

☐ resistant sandstone forms overhangs above weaker shale layers
☐ weaker shale forms protective caps above more resistant sandstone

7 Several statements about weathering and erosion in Letchworth Gorge are listed below.

Statement 1: Shale in Letchworth Gorge erodes at a faster rate than sandstone under all conditions shown in the graph.

Statement 2: Sandstone is more resistant to freeze-thaw weathering than shale because it has lower porosity.

Statement 3: Rocks in Letchworth Gorge are composed primarily of Cambrian-aged metamorphic rock.

Statement 4: Location Y shows evidence of cliff undercutting where weaker layers erode beneath stronger layers.

Statement 5: Acid rain has no effect on any of the rocks in the Letchworth Gorge walls.

Statement 6: The Genesee River continues to deepen the gorge through erosion and transport of sediment.

Which statements correctly describe weathering and erosion in Letchworth Gorge?

(1) Statements 1, 4, 6

(2) Statements 2, 3, 5

(3) Statements 1, 3, 5

(4) Statements 2, 4, 6

8 Write the correct letter from the choices below on the line at the end of each sentence to complete each statement about weathering and erosion in Letchworth Gorge. *[1]*

Choices for Statement 1:

A – be more resistant because sand grains are strongly cemented by silica
B – be less resistant because quartz grains dissolve rapidly in fresh water

Choices for Statement 2:

C – undercutting by the river and rockfalls from weaker layers above
D – slow chemical weathering of sand grains within the riverbed

Choices for Statement 3:

E – reduce landslide risk by adding heavy structures to the cliff face
F – reduce landslide risk by placing trails near more stable sandstone layers

Statement 1: Sandstone layers in the gorge are predicted to _______.

Statement 2: The widening of the gorge over time is caused by _______.

Statement 3: Hiking trail planners should _______.

9 A student makes a claim that the safest hiking trail should be built near location X rather than location Y, based on the photograph and the erosion-rate graph. Which statement provides the most correct evidence to support this claim?

(1) Location X is closer to the Genesee River where sandstone is more resistant and there is less risk of cliff collapse, while location Y is on a steep cliff face where undercutting of shale produces landslides.

(2) Location Y is at the base of the gorge where flooding is most frequent, so a trail there would be destroyed by seasonal ice jams each winter.

(3) Location X is located on a steep cliff face made entirely of unconsolidated sediment, which makes it the most stable location for a trail.

(4) Location Y is directly exposed to the most chemical weathering in the gorge because it is closer to the bottom of the river, where water has the highest acidity.

10 A student makes the following claim:

"If the Genesee River were to dry up completely, Letchworth Gorge would stop widening and the shale layers would no longer break down."

Place a check mark (✓) in either the Support or Refute box below. Justify your response using evidence from the reading and the graph. *[1]*

☐	**Support**
☐	**Refute**

Justification:

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CLUSTER 3 • Questions 11–15

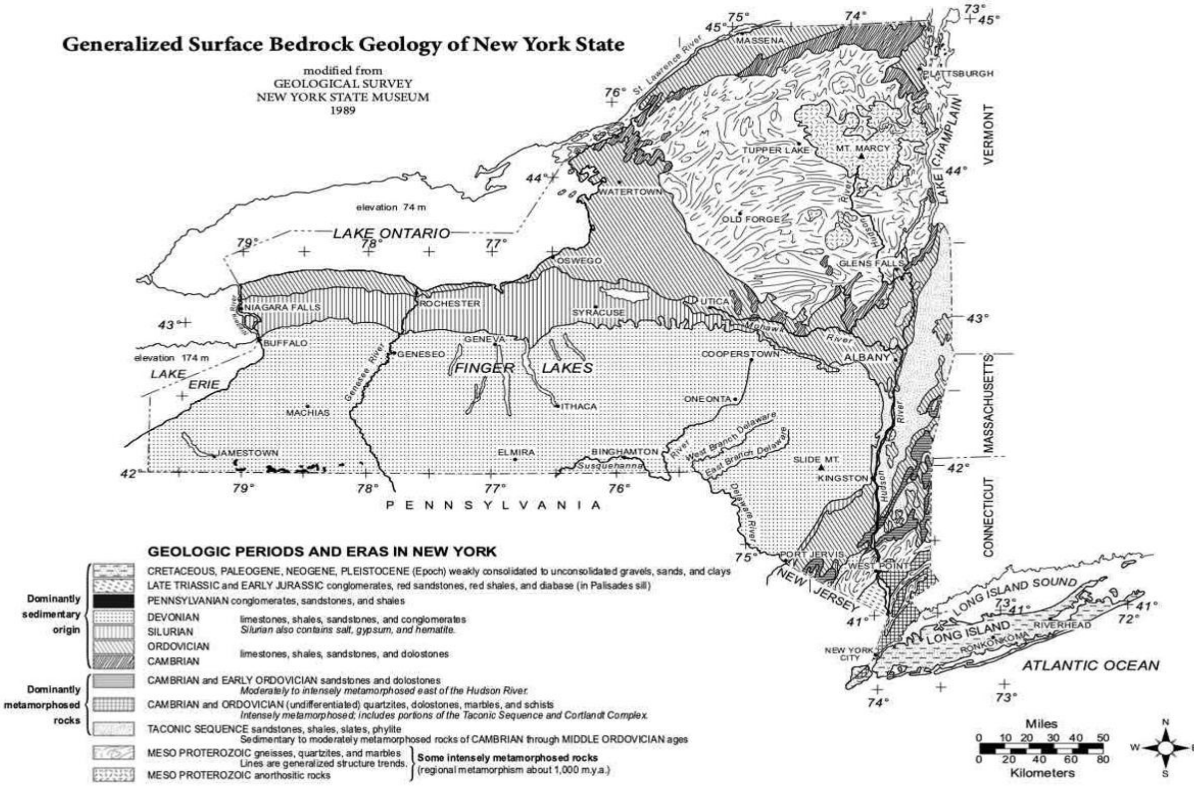
Base your answers to questions 11 through 15 on the information below and on your knowledge of Earth and Space Sciences. Some questions may require the use of the 2024 Edition Reference Tables for Earth and Space Sciences.

Glacial Erosion and the Shaping of New York State

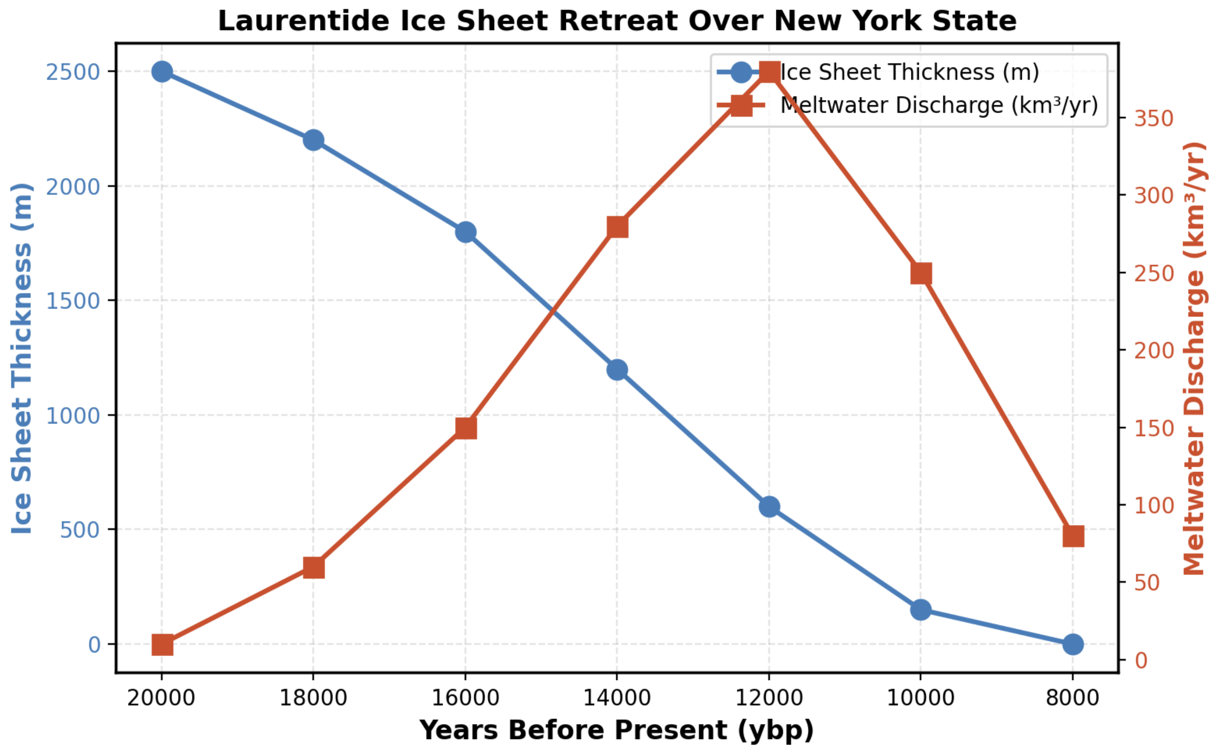
Approximately 20,000 years ago, a massive continental ice sheet called the **Laurentide Ice Sheet** covered nearly all of New York State. At its maximum, this ice was over 2,500 meters thick and extended as far south as Long Island. As the climate warmed, the glacier melted and retreated northward. The last of the ice left New York approximately 8,000 years ago. As the ice moved, it weathered and eroded the bedrock beneath it through two main processes: **plucking**, in which meltwater freezes onto bedrock and tears rocks loose as the glacier advances; and **abrasion**, in which rock fragments carried within the ice scratch and grind down bedrock like sandpaper.

Glacial erosion carved many of New York's most recognizable landforms. The **Finger Lakes** are long, narrow, deep lakes formed when glaciers deepened and widened existing stream valleys into U-shaped troughs. The **Adirondack Mountains** show rounded summits and scoured bedrock where glaciers passed over them. **Long Island** and **Staten Island** are composed of sand, gravel, and boulders dropped by the melting glacier — material called **glacial till** and **outwash**. These deposits remain the source of many mineral resources and groundwater supplies today. Human activities in New York — including mining, construction, and road salt use — interact with these glacial landscapes and can accelerate erosion.

Generalized Surface Bedrock Geology of New York State



Retreat of the Laurentide Ice Sheet over New York State



11 Complete each of the three statements below by placing an X in the box to correctly describe glacial processes that shaped New York State. *[1]*

Statement 1:

Evidence from the graph indicates that the Laurentide Ice Sheet reached its maximum thickness

☐ approximately 20,000 years before present
☐ approximately 8,000 years before present

Statement 2:

According to the graph, meltwater discharge was highest when

☐ the ice sheet was thickest and not yet melting
☐ the ice sheet was rapidly thinning and retreating

Statement 3:

The Finger Lakes of central New York were formed primarily by

☐ glacial plucking and abrasion deepening existing stream valleys
☐ volcanic activity and rifting of crustal plates

12 A student recorded the following observations while studying a landform in central New York.

A	The valley is deep, narrow, and has a U-shaped cross-section
B	The bedrock at the base of the valley shows long parallel scratches
C	The valley sides are composed of young Cretaceous sand and gravel
D	Large boulders of different rock types are found scattered in the valley
E	The valley was formed by active volcanoes during the Cenozoic
F	The valley walls are composed of rounded, cemented sandstone grains

Which set of observations would provide the best evidence that this valley was formed by glacial erosion?

(1) Observations A, B, and D

(2) Observations C, E, and F

(3) Observations A, C, and E

(4) Observations B, D, and F

13 Several statements about glacial weathering and erosion in New York are listed below.

Statement 1: Glacial ice over New York reached its maximum thickness approximately 8,000 years ago.

Statement 2: Long Island is made of sediment deposited at the southernmost extent of the glacier.

Statement 3: Parallel scratches (striations) on bedrock are evidence of abrasion by debris-carrying ice.

Statement 4: The Adirondack Mountains were formed when a glacier deposited them as a terminal moraine.

Statement 5: Glacial meltwater can redistribute eroded sediment and create deposits of outwash.

Statement 6: All of the bedrock underneath Long Island is Precambrian-age metamorphic rock.

Which three statements correctly describe glacial weathering and erosion in New York?

(1) Statements 1, 4, 6

(2) Statements 2, 3, 5

(3) Statements 1, 2, 4

(4) Statements 3, 5, 6

14 Using the graph and the reading, place the events below in the correct temporal sequence, from oldest (first) to youngest (last). Justify your sequence using evidence from the graph. *[1]*

Events:

- Laurentide Ice Sheet reaches its maximum thickness over New York
- Meltwater discharge peaks as the glacier rapidly retreats
- Glaciers deposit sand and gravel that form Long Island
- All ice has left New York State
- Glaciers begin slowly retreating from central New York

Oldest	1. ______________________________
	2. ______________________________
	3. ______________________________
	4. ______________________________
Youngest	5. ______________________________

Justification:

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15 A student makes the claim that glacial erosion, rather than the work of modern rivers, is the primary reason the Finger Lakes are so deep and narrow today. Which statement uses evidence from the reading and graph to best support this claim?

(1) Continental ice over 2,500 meters thick deepened and widened pre-existing stream valleys through plucking and abrasion, producing the characteristic U-shaped, deep basins the Finger Lakes occupy today.

(2) Modern streams in central New York have been continuously removing sediment from the Finger Lakes for the last 20,000 years, deepening them more than any ice sheet could.

(3) The Finger Lakes were formed when volcanic eruptions during the Cretaceous Period melted glaciers and collapsed the bedrock into deep valleys.

(4) The Finger Lakes sit above large deposits of carbonate bedrock that dissolve in water, which explains why they are deeper than other lakes in New York.

CLUSTER 4 • Questions 16–20

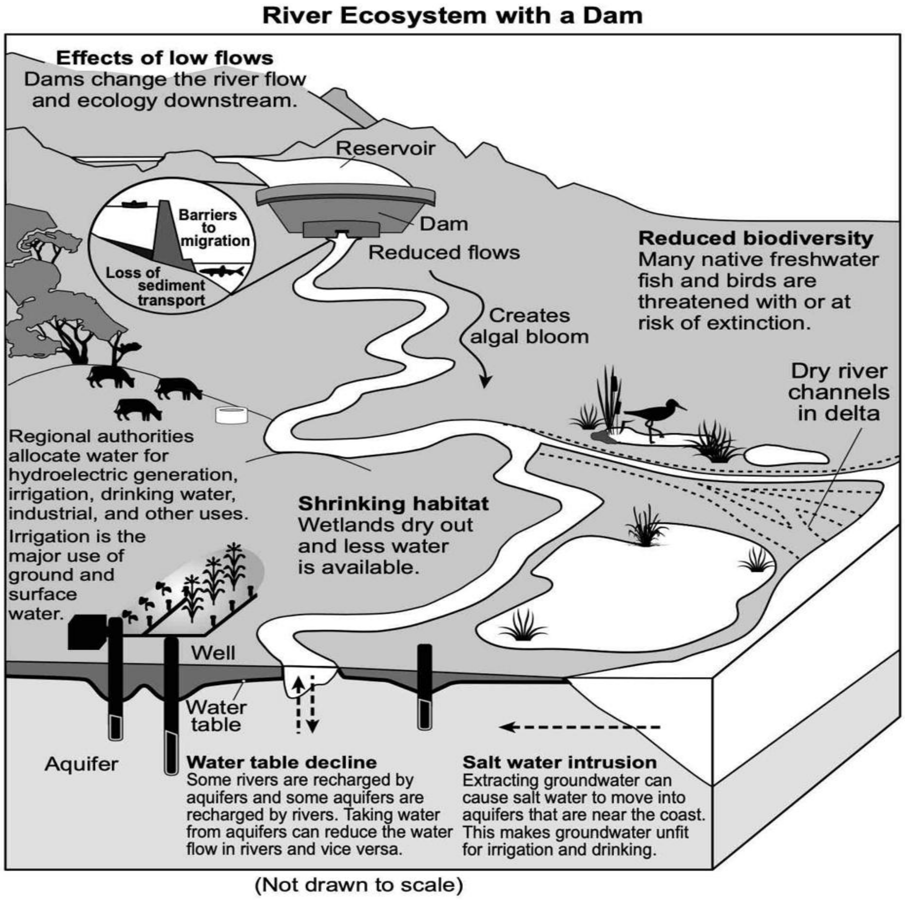
Base your answers to questions 16 through 20 on the information below and on your knowledge of Earth and Space Sciences. Some questions may require the use of the 2024 Edition Reference Tables for Earth and Space Sciences.

Dams and the Disruption of River Erosion

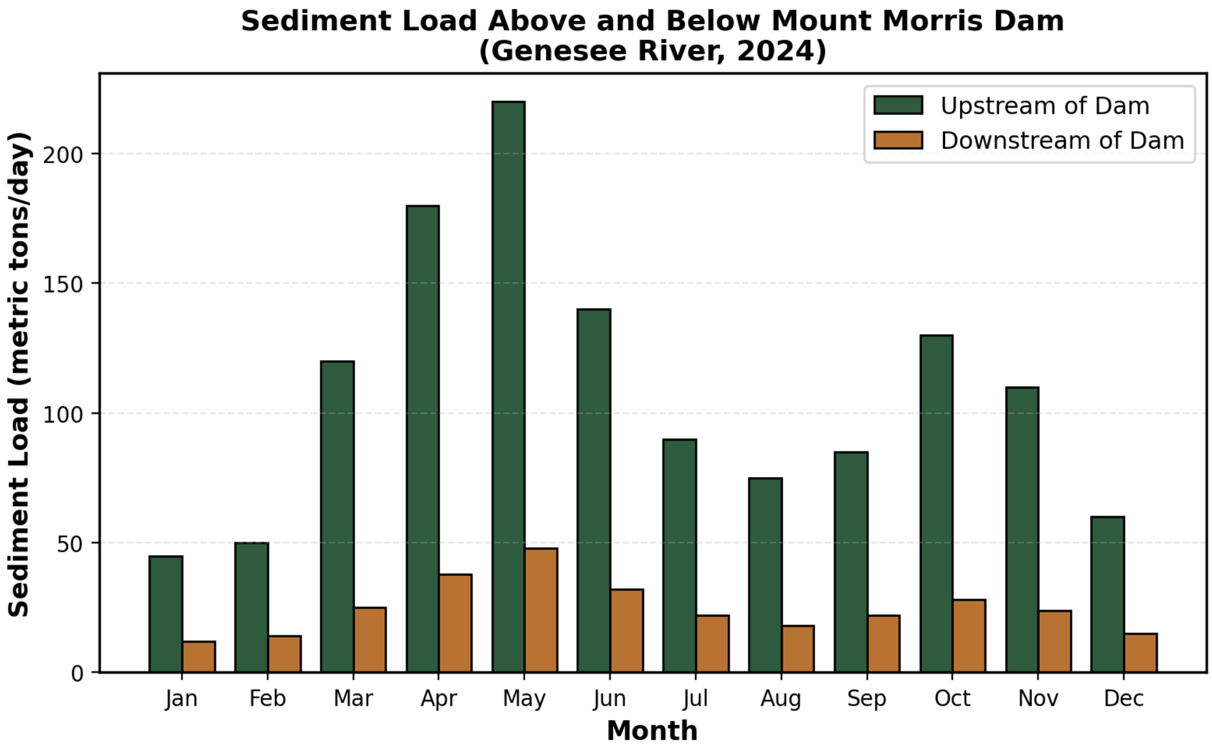
Rivers are major agents of weathering, erosion, and deposition that shape Earth's surface. Under natural conditions, a river continuously picks up sediment from its bed and banks and transports it downstream, eventually depositing it at the mouth in a delta. Human-built **dams** — such as the Mount Morris Dam on the Genesee River in Letchworth State Park — interrupt this natural sediment transport. When water slows behind a dam, sediment settles out in the reservoir. The water released downstream is "sediment-starved," meaning it carries less sediment than it did before the dam was built. This sediment-hungry water can accelerate erosion of the riverbed and banks downstream of the dam.

Dams also disrupt other Earth systems. Fish migration is blocked by the physical barrier. Wetland ecosystems downstream lose the nutrient-rich sediment they depend on, which can reduce biodiversity. Deltas at the river mouth — which act as natural protection against coastal flooding — can shrink because less sediment arrives at the coast. Some dams are beneficial, however: the Mount Morris Dam was built for flood control and has prevented severe flooding in Rochester since its completion in 1952. Regional authorities must balance the benefits of dams (flood control, hydroelectric power, drinking water) against these environmental impacts.

River Ecosystem with a Dam



Sediment Load Above and Below Mount Morris Dam



16 Complete each of the three statements below by placing an X in the box to correctly describe how dams affect weathering and erosion. ***[1]***

Statement 1:

Evidence from the graph shows that, compared to upstream, sediment load downstream of the Mount Morris Dam is

☐ much lower throughout the entire year
☐ much higher during all months of the year

Statement 2:

Sediment-starved water released below a dam tends to

☐ increase erosion of the riverbed and banks downstream
☐ deposit more material and build up the riverbed downstream

Statement 3:

An impact of reduced sediment at the river mouth is that

☐ coastal delta ecosystems shrink and lose protection against flooding
☐ coastal delta ecosystems grow larger and protect against storm surge

17 Write the correct letter from the choices below on the line at the end of each sentence to complete each statement about the environmental impacts of the Mount Morris Dam. *[1]*

Choices for Statement 1:

A – increase the sediment load in the Genesee River upstream of the dam
B – reduce property damage and flooding in communities like Rochester

Choices for Statement 2:

C – block fish migration and reduce the biodiversity of native species
D – allow fish to pass freely and increase overall species biodiversity

Choices for Statement 3:

E – starve downstream wetlands of nutrient-rich sediments
F – add excess sediments to downstream wetlands, causing rapid growth

Statement 1: A benefit of the Mount Morris Dam is that it can _______.

Statement 2: A negative impact of the dam on the biosphere is that it can _______.

Statement 3: Over time, downstream habitats may change because the dam can _______.

18 A student makes a claim that the Mount Morris Dam provides a net benefit to the Rochester area but causes negative impacts on downstream Earth systems. Using the reading and graph, which statement provides the most correct evidence to support this claim?

(1) The dam reduces flood risk for Rochester residents while also reducing downstream sediment load every month of the year, which starves downstream wetlands and deltas of nutrient-rich material.

(2) The dam completely stops all river flow through the Genesee River year-round, which eliminates all flooding but also eliminates the river ecosystem downstream entirely.

(3) The dam collects sediment upstream, which causes downstream beaches to grow larger than upstream reservoirs, increasing coastal flooding in Rochester.

(4) The dam releases more sediment downstream during storm events than upstream, which damages the city of Rochester but restores wetlands along the coast.

19 A student observed a section of a river 5 kilometers downstream of the Mount Morris Dam and recorded the following observations.

A	The river channel has become noticeably deeper over the past 25 years
B	Sediment deposits along the banks are thick and actively growing
C	The riverbanks show evidence of slumping and steep cut banks
D	Exposed tree roots are visible where soil has washed away along the banks
E	New sandbars are forming in the center of the river channel every year
F	Fish and aquatic insect populations show lower species diversity than upstream

Which set of observations provides the best evidence of increased erosion downstream of the dam?

(1) Observations A, C, and D

(2) Observations B, C, and E

(3) Observations A, B, and E

(4) Observations D, E, and F

20 A student makes the following claim:

"Removing the Mount Morris Dam would immediately restore sediment flow downstream and would have no negative impacts on communities along the Genesee River."

Place a check mark (✓) in either the Support or Refute box below. Justify your response using evidence from the reading and/or graph. *[1]*

☐	**Support**
☐	**Refute**

Justification:

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CLUSTER 5 • Questions 21–25

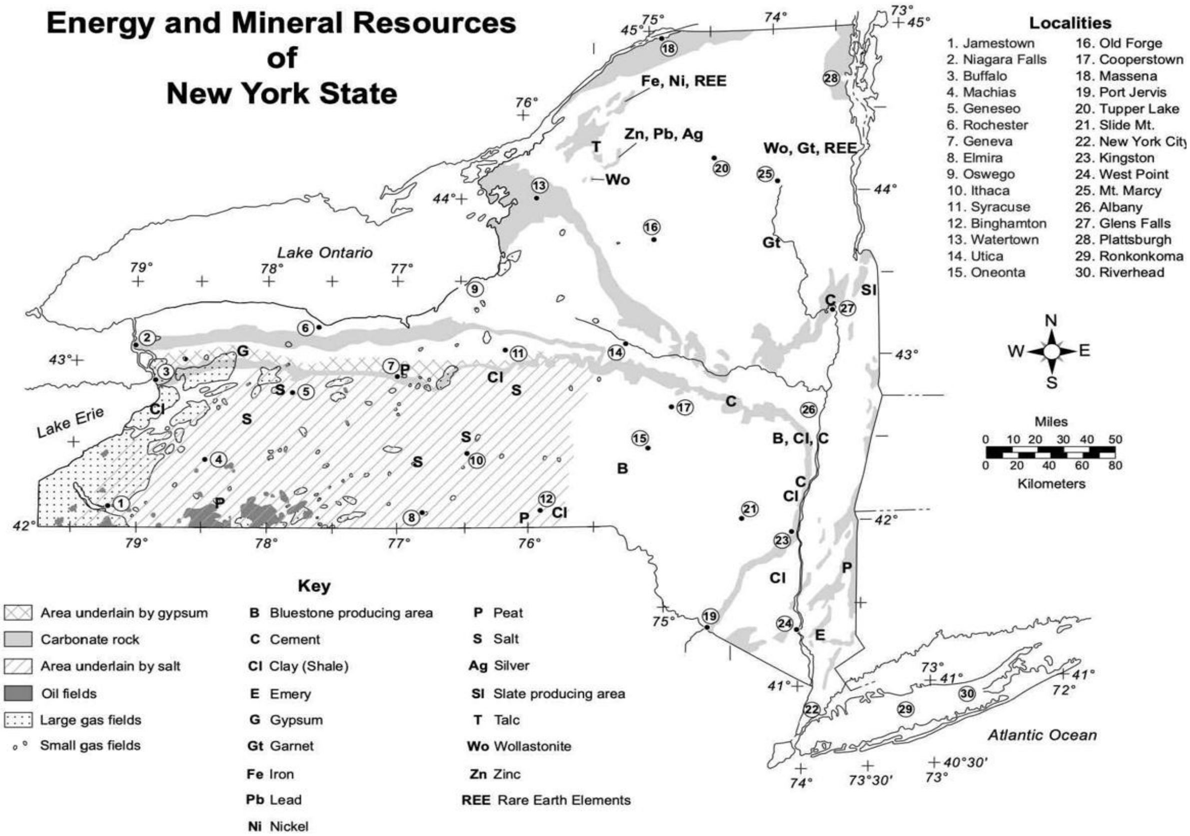
Base your answers to questions 21 through 25 on the information below and on your knowledge of Earth and Space Sciences. Some questions may require the use of the 2024 Edition Reference Tables for Earth and Space Sciences.

Mine Reclamation and Soil Erosion in New York State

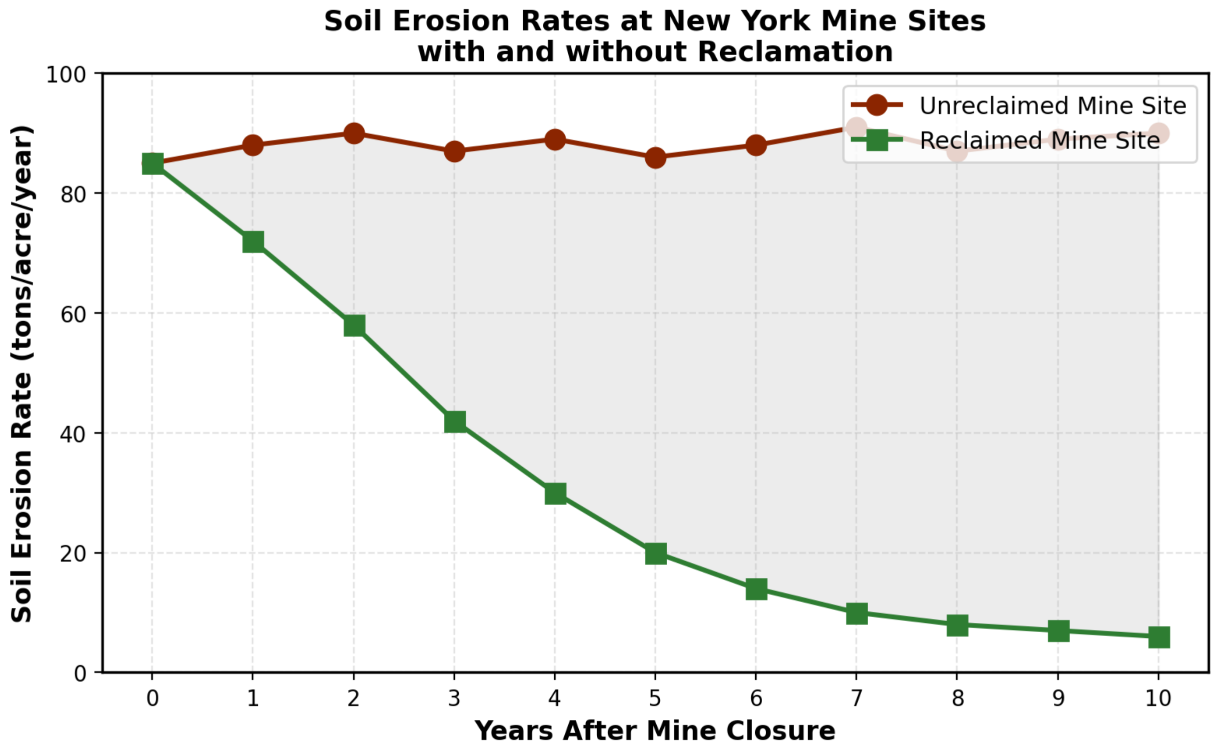
New York State contains a wide variety of mined mineral and energy resources. Carbonate rock, salt, gypsum, garnet, peat, and natural gas are all mined across the state. When a mine is active, surface vegetation and topsoil are removed to expose the ore or mineral below. This exposes bare soil and rock to wind, water, and gravity — dramatically accelerating weathering and erosion. Without plants to hold the soil in place and roots to slow water flow, eroded sediment can wash into nearby streams, damage habitats, clog waterways, and reduce water quality for communities downstream.

New York State law requires that mines be **reclaimed** after they are no longer in operation. Reclamation is the process of returning the land to an ecologically or economically usable condition. Typical reclamation activities include **regrading the land** to stable slopes, replacing **topsoil**, planting **native vegetation**, and creating **retention ponds** to capture sediment-laden runoff. These steps restore the land's resistance to erosion by re-establishing the plant cover and root systems that naturally slow down weathering and runoff. The graph on the next page compares erosion rates at reclaimed and unreclaimed mine sites over a 10-year period after closure.

Energy and Mineral Resources of New York State



Soil Erosion Rates at Reclaimed vs. Unreclaimed NY Mine Sites



21 Complete each of the three statements below by placing an X in the box to correctly describe how mining and mine reclamation affect weathering and erosion. *[1]*

Statement 1:

Evidence from the graph shows that, after 10 years, the erosion rate at a reclaimed site compared to an unreclaimed site is

☐ much lower at the reclaimed site than at the unreclaimed site

☐ about the same at both sites, showing reclamation has no effect

Statement 2:

One reason erosion rates are high at unreclaimed sites is that

☐ bare exposed soil has no plant roots to hold sediment in place

☐ exposed bedrock is completely resistant to all weathering processes

Statement 3:

Retention ponds built during reclamation protect downstream communities by

☐ capturing sediment-laden runoff before it enters streams and rivers

☐ releasing extra sediment into streams to raise water levels for drinking

22 Several statements about mine reclamation and erosion in New York are listed below.

Statement 1: Without reclamation, erosion rates at New York mine sites remain near 85–90 tons/acre/year for over a decade after closure.

Statement 2: Replanting native vegetation during reclamation increases soil erosion because plant roots loosen sediment.

Statement 3: Sediment washed from unreclaimed mines can reduce water quality in nearby streams and clog aquatic habitats.

Statement 4: Reclamation has reduced erosion rates to less than 10 tons/acre/year within 7 years of mine closure.

Statement 5: New York State laws do not require any reclamation activities for mines after they are closed.

Statement 6: Regrading slopes and replacing topsoil during reclamation both decrease the rate of erosion.

Which three statements correctly describe mine reclamation and erosion in New York?

(1) Statements 1, 4, 6

(2) Statements 2, 3, 5

(3) Statements 1, 3, 6

(4) Statements 2, 4, 5

23 Write the correct letter from the choices below on the line at the end of each sentence to complete each statement about reclaiming a closed New York State mine. ***[1]***

Choices for Statement 1:

A – reduce the force of runoff on exposed soil and slow sediment transport
B – increase wind erosion on bare slopes to expose deeper minerals

Choices for Statement 2:

C – capture sediment-laden runoff and restore downstream water quality
D – release contaminated runoff directly into nearby rivers

Choices for Statement 3:

E – re-establish root systems and restore the original ecosystem
F – permanently destroy the native ecosystem and introduce invasive species

Statement 1: Regrading the slopes of the mine pit will _______.

Statement 2: Constructing a retention pond near the reclaimed mine will _______.

Statement 3: Planting native grasses and trees around the mine will _______.

24 Place the reclamation steps below in the correct sequence, from the first step to the last step, that a reclamation team would follow to restore a closed New York State mine site. Justify your sequence using evidence from the reading. ***[1]***

Steps:

- Plant native vegetation such as grasses and trees
- Regrade the steep mine pit walls to stable, gentle slopes
- Replace topsoil across the graded surface
- Install retention ponds to capture sediment-laden runoff
- Monitor the site to ensure erosion rates decrease over time

First	1. ______________________________
	2. ______________________________
	3. ______________________________
	4. ______________________________
Last	5. ______________________________

Justification:

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25 A student makes the claim that mine reclamation is a successful engineering solution to reduce the environmental impacts of mining on New York's Earth systems. Using the reading and graph, which statement provides the most correct evidence to support this claim?

(1) Reclaimed mine sites showed erosion rates drop from about 85 tons/acre/year to under 10 tons/acre/year within 7 years, which protects nearby streams and ecosystems from sediment pollution.

(2) Reclaimed mine sites showed erosion rates that remained constant at about 85 tons/acre/year for 10 years, the same as unreclaimed sites, which means erosion cannot be controlled.

(3) Reclaimed mine sites released more sediment into streams than unreclaimed sites, improving downstream fisheries and restoring native fish populations.

(4) Reclaimed mine sites require no regrading, replanting, or retention ponds, because New York bedrock naturally resists all forms of weathering and erosion.

DATA TABLE • Weathering & Erosion Summary

Directions: Using information from the five clusters above, complete the summary data table below. Each correctly completed row is worth **1 point** (total of **4 points**).

Location	Main Erosion Agent	Human Solution	Effect on Earth System
Long Island South Shore			
Letchworth Gorge			
Finger Lakes (Central NY)			
Mount Morris Dam Area			
Reclaimed NY Mine Sites			

Each completed row = 1 point • Data table total = 4 points (first 4 rows scored)

FINAL GRADE CALCULATION

Scoring Breakdown

Each multiple-choice and constructed-response question is worth **1 point**. The completed Data Table is worth **4 points**. Calculate your final grade below.

Section	Points Possible	Points Earned
Cluster 1 (Questions 1–5)	5	______
Cluster 2 (Questions 6–10)	5	______
Cluster 3 (Questions 11–15)	5	______
Cluster 4 (Questions 16–20)	5	______
Cluster 5 (Questions 21–25)	5	______
Data Table	4	______
TOTAL	**29**	_____

Final Grade Formula:

Final Percentage Grade = (Points Earned ÷ 29) × 100

My Final Grade: _______ / 29 = _______%

Mastery Target: 60% or higher shows Regents-level mastery of weathering and erosion with human impact.

ANSWER KEY

For Teacher Use • 25 Questions • Regents-Aligned Responses

CLUSTER 1 — Long Island Coastal Erosion

1. Statement 1: poorly cemented sediments deposited by continental glaciers ✓ • Statement 2: shoreline to migrate westward along the south shore ✓ • Statement 3: hurricanes and nor'easters producing large storm waves ✓

2. (1) Observations A, D, and F — well-sorted rounded grains, smooth wave-abraded surfaces, and crushed shells all indicate significant wave weathering/erosion.

3. (1) Beach nourishment at Westhampton maintained beach widths above 80 meters through 2024 without blocking longshore sand transport, while locations with no protection (Fire Island) showed continuous loss.

4. 1. Fire Island (greatest loss — 95 m → 38 m ≈ 57 m lost) • 2. Westhampton (85 m → 95 m — net gain but cyclical loss during nourishment gaps) • 3. Jones Beach (120 m → 108 m ≈ 12 m lost). **Justification:** Fire Island lost the most beach width (~57 m) because it had no human protection; Jones Beach lost the least (~12 m) because jetties/groins trapped longshore sand.

5. REFUTE. Jetties trap sand on their updrift side but starve beaches on the downdrift (westward) side of the sand they would have received via longshore transport. Therefore, building more jetties would cause accelerated erosion to west-lying beaches, not protect them.

CLUSTER 2 — Letchworth Gorge

6. Statement 1: higher erosion rates caused by freeze-thaw cycles and mechanical abrasion ✓ • Statement 2: shale is fine-grained and splits easily along bedding planes ✓ • Statement 3: resistant sandstone forms overhangs above weaker shale layers ✓

7. (1) Statements 1, 4, 6 — shale erodes faster (graph), Y shows undercutting, and the Genesee River continues to erode.

8. Statement 1: A • Statement 2: C • Statement 3: F

9. (1) Location X is closer to the river where sandstone is more resistant; Y is on a steep cliff where shale undercutting causes landslides.

10. REFUTE. Even without the river, weathering would continue: freeze-thaw, mechanical abrasion, and chemical weathering of shale (shown in the graph) happen independently of river flow. The river accelerates erosion but does not cause all of it.

CLUSTER 3 — Glacial Weathering in NY

11. Statement 1: approximately 20,000 years before present ✓ • Statement 2: the ice sheet was rapidly thinning and retreating ✓ • Statement 3: glacial plucking and abrasion deepening existing stream valleys ✓

12. (1) Observations A, B, and D — U-shaped valley, parallel scratches (striations), and scattered boulders (erratics) are all classic glacial evidence.

13. (2) Statements 2, 3, 5 — Long Island is glacial till, striations are abrasion evidence, and meltwater deposits outwash.

14. 1. Laurentide Ice Sheet reaches maximum thickness (20,000 ybp) • 2. Glaciers begin slowly retreating from central NY (18,000–16,000 ybp) • 3. Glaciers deposit sand/gravel forming Long Island (~18,000–14,000 ybp) • 4. Meltwater discharge peaks (~12,000 ybp) • 5. All ice has left NY (~8,000 ybp). **Justification:** The graph shows ice thickness peaks at 20,000 ybp, meltwater peaks around 12,000 ybp, and ice reaches 0 m at ~8,000 ybp.

15. (1) Continental ice over 2,500 m thick deepened pre-existing stream valleys through plucking and abrasion, producing the characteristic U-shaped basins of the Finger Lakes.

CLUSTER 4 — Dams and River Erosion

16. Statement 1: much lower throughout the entire year ✓ • Statement 2: increase erosion of the riverbed and banks downstream ✓ • Statement 3: coastal delta ecosystems shrink and lose protection against flooding ✓

17. Statement 1: B • Statement 2: C • Statement 3: E

18. (1) The dam reduces flood risk for Rochester residents while also reducing downstream sediment load every month, which starves downstream wetlands and deltas.

19. (1) Observations A, C, and D — deeper channel, slumping/cut banks, and exposed tree roots are all direct evidence of increased erosion.

20. REFUTE. Removing the dam would restore sediment flow but would eliminate flood protection for Rochester, potentially causing serious flooding events. The reading explains the dam has prevented severe flooding since 1952.

CLUSTER 5 — Mine Reclamation & Soil Erosion

21. Statement 1: much lower at the reclaimed site than at the unreclaimed site ✓ • Statement 2: bare exposed soil has no plant roots to hold sediment in place ✓ • Statement 3: capturing sediment-laden runoff before it enters streams and rivers ✓

22. (3) Statements 1, 3, 6 — unreclaimed rates stay high, sediment damages streams, and regrading/replacing topsoil reduces erosion.

23. Statement 1: A • Statement 2: C • Statement 3: E

24. 1. Regrade the steep mine pit walls • 2. Replace topsoil across the graded surface • 3. Install retention ponds • 4. Plant native vegetation • 5. Monitor the site. **Justification:** Reclamation follows a sequence — first stabilize slopes, then rebuild soil, install water controls, replant, and verify with monitoring. The graph shows erosion drops steadily after these steps are taken.

25. (1) Reclaimed sites dropped from ~85 tons/acre/year to under 10 tons/acre/year within 7 years, protecting nearby streams and ecosystems.

DATA TABLE — Sample Responses (4 points total)

Location	Main Erosion Agent	Human Solution	Effect on Earth System
Long Island South Shore	Wave action & longshore currents	Beach nourishment / jetties	Protects coastal biosphere; alters sand transport in hydrosphere
Letchworth Gorge	River erosion & differential weathering	Trail planning near stable rock	Shapes geosphere (gorge widens over time)
Finger Lakes (Central NY)	Glacial plucking & abrasion	Conservation / shoreline protection	Created hydrosphere features; ongoing freshwater storage
Mount Morris Dam Area	Sediment-starved river erosion	Dam for flood control	Reduces flooding (geosphere); alters downstream biosphere
Reclaimed NY Mine Sites	Wind/water erosion of bare soil	Regrading, topsoil, replanting, retention ponds	Restores biosphere; protects hydrosphere from sediment