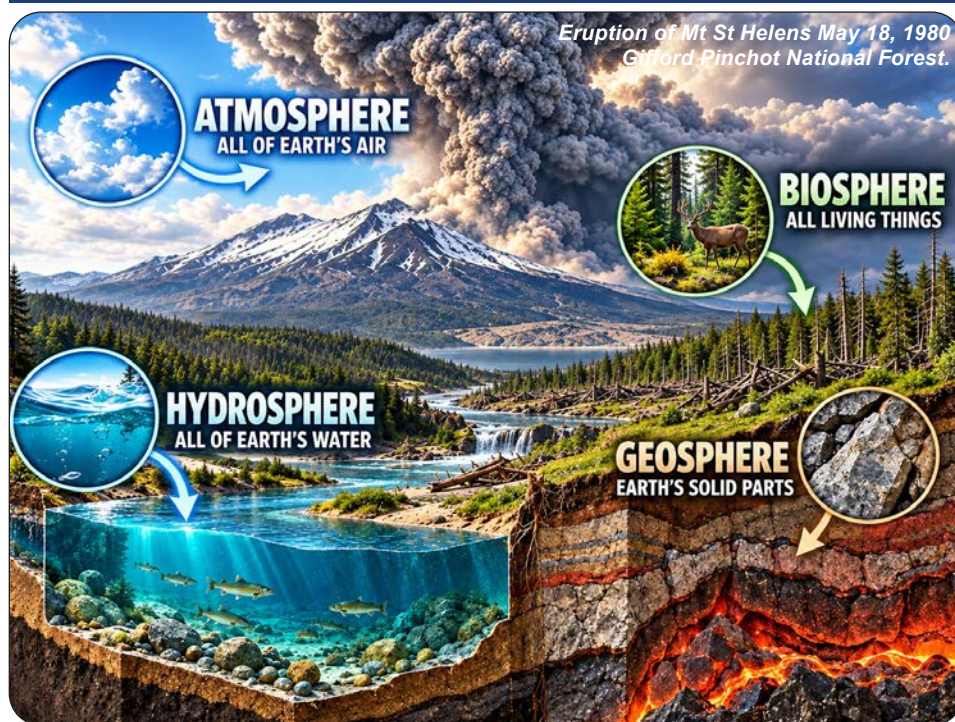




Lesson Objective

You will differentiate between Earth's four systems and explain how they change the land around you at different speeds. You will also connect this science to real STEM careers that communities depend on for decisions about water, land, and safety.

Standards: NGSS MS-ESS2-2 explains how geoscience processes have reshaped Earth's surface over time and space.

TEKS 6.10A and 6.4C cover Earth's four systems and STEM career exploration.

Essential Question: What is happening in the ground, water, and air around your home right now that you can't actually see?

Top 3 Concepts

- 1 Four Earth Systems Meet in Your Backyard**
Every place you live is shaped by four connected systems: the ground, water, air, and living things.
- 2 Slow Change and Sudden Change Both Reshape Land**
Some changes happen so slowly you would need years to notice them; others happen in seconds.
- 3 Reading the Land Is an Actual Career**
People with jobs like hydrologist and geotechnical engineer study these systems to help communities plan for water and hazards.

Why This Matters

This week, the weather forecast you checked and the water from your tap were studied by Earth scientists such as hydrologists, who measure water supplies so your county knows when to ask families to conserve water during a dry summer. The same science that explains faraway volcanoes also explains the hills, streams, and soil right around your home.



Prediction

Based on the three concepts above, make a prediction about which Earth system — the ground, water, air, or living things — you think changes the fastest where you live.

Four Systems, One Living Landscape

On May 18, 1980, Mount St. Helens lost about 400 meters (1,300 feet) of elevation in a massive landslide and eruption. The collapsing summit triggered an explosive blast within seconds. Ash fell across 11 U.S. states. Rivers changed course. Forests that had stood for centuries were flattened almost instantly. That single morning changed the land, the sky, and the water for miles around. It proved that Earth's systems are never truly separate.

Four Systems Share Every Landscape

Stand outside for one minute and you are standing inside four systems at once. The solid parts of Earth, including the rock, soil, and mountains beneath your feet, make up the *geosphere*. Every stream, lake, ocean, glacier, puddle, and source of groundwater near your home belongs to the *hydrosphere*. That word means all of Earth's water, wherever it is found.

Above your head, the mix of gases you breathe is the *atmosphere*. The trees, grass, insects, and you yourself are part of the *biosphere*, the layer of living things. These four systems overlap constantly. **A single rainstorm touches all four systems** in under an hour. It falls from the atmosphere and soaks into the geosphere. Then it fills streams in the hydrosphere and gets used by plants and animals in the biosphere. That overlap is why **Earth scientists rarely study just one thing**. Even a hillside check near your school means thinking about rainfall and plant roots too. Your own backyard or schoolyard proves these systems are always working together.



Figure x.1 - A single hillside holds rock, water, air, and living things together. Every landscape you visit is really four systems layered on top of each other.



Figure x.2 - A creek cuts through soil and rock at the water's edge. Look closely and you can find at least three of the four Earth systems in this single photo.



STOP AND THINK: Look at Figure x.2 — which of the four systems can you spot in that photo, and which one is missing from the frame?



Figure x.3 - This diagram compares two ways a hillside can change over time. One side shows slow erosion across thousands of years, and the other shows a landslide in seconds.

Landscapes Change at Two Very Different Speeds

Some changes to the geosphere take so long that no person could ever watch them happen. Wind and rain slowly break rock into smaller pieces through *weathering*. This process can take hundreds or thousands of years to turn a boulder into sand. Moving water, wind, or ice then carries the broken pieces away in a process called *erosion*. This reshapes hills and valleys over *geologic time*, spans of thousands to millions of years. A river carving a canyon barely moves its walls in one human lifetime.

Change is not always slow, though. In a place hit by sudden, heavy rain, **one storm can outweigh a hundred quiet years**. When a hillside gets more rain than it can absorb, the extra water can trigger a landslide. This fast-moving *hazard* links the atmosphere, hydrosphere, and geosphere within seconds. **Fast events and slow events shape the land**, just at different speeds in different places.



STOP AND THINK: Look at Figure x.3 — which arrow in the diagram shows the fastest change, and which one shows the slowest?

This Science Leads to Real Jobs

People who study these four systems are not only working in classrooms. Many hold real jobs that keep communities safe every day. A *hydrologist* measures how much water is stored in rivers, lakes, and underground. That tells a county how much is safe to use during a dry summer. A geotechnical engineer tests soil and rock before a road or building is built. This checks whether the ground can hold the weight. **Their measurements decide where we can safely build.**

Meteorologists track the atmosphere to warn families before severe storms arrive. Emergency managers use that same information to decide when to open a shelter. GIS technicians combine data about the geosphere, hydrosphere, and biosphere into maps. A city planner might use one of these maps to choose where a new park or storm drain goes. **A scientist's map can shape a family's choices.** Every one of these jobs depends on understanding how the four

Earth systems connect. That is why this science shows up in everyday decisions.

?

STOP AND THINK: Figure x.6 compares two job sites side by side. Which system — geosphere, hydrosphere, atmosphere, or biosphere — is each worker most likely measuring?

Case Study —

Bingham Canyon, Utah, April 10, 2013

Engineers at the Bingham Canyon copper mine in Utah had used ground sensors for months. The sensors tracked tiny shifts in the canyon wall. These changes were too small for a person to feel by standing there. On the night of April 10, 2013, those instruments picked up a change large enough to trigger a warning. The mine was evacuated hours before the slope failed. Tens of millions of cubic meters of rock and soil slid down the canyon wall. It was one of the largest landslides ever recorded in North America. Because scientists had been watching the geosphere carefully, no workers were hurt.

THINK LIKE A SCIENTIST

A county has money to hire only one new scientist. Using what you know about the four systems, slow versus sudden change, and real Earth science jobs, which job should the county fund, and why?



Figure x.4 - A hydrologist checks water quality where a stream meets its bank. Fieldwork like this turns the hydrosphere into numbers a county can actually use.



Figure x.5 - Bingham Canyon Mine shows how far a landslide can travel. Ground sensors gave workers enough warning to evacuate hours before the slope gave way.



Figure x.6 - Two Earth science jobs, two very different work settings. Which worker do you think spends more time outdoors, and why might that matter?

GUIDED NOTES



Complete the guided notes as you read, using key ideas and evidence from the article to organize and strengthen your understanding.

Three Most Important Concepts

Based on the article, identify and explain the three most important topics you learned:

Concept 1: _____

Concept 2: _____

Concept 3: _____

Main Concept Overview

Fill in each blank using one word from the box. Each sentence restates a big idea from the article.

Word Bank: map | years | scientists | systems | measurements

1. A single rainstorm can touch all four _____ at once.
2. Because the four systems overlap, Earth _____ rarely study just one thing.
3. In some places, one powerful storm can cause more change than a hundred quiet _____.
4. A geotechnical engineer's _____ decide where it is safe to build.
5. A scientist's _____ can shape a family's choices, like whether to buy flood insurance.

Matching Section

Match each job to what it does. Write the correct letter on the line.

- | | |
|--------------------------------|---|
| _____ 1. Hydrologist | A. Combines geosphere, hydrosphere, and biosphere data into maps used for planning. |
| _____ 2. Geotechnical Engineer | B. Tests soil and rock before construction to see if the ground can hold weight. |
| _____ 3. Meteorologist | C. Decides when to open a shelter based on storm warnings. |
| _____ 4. Emergency Manager | D. Measures how much water is stored in rivers, lakes, and underground. |
| _____ 5. GIS Technician | E. Tracks the atmosphere to warn families before severe storms. |

True/False

Mark each statement T (true) or F (false).

- _____ 1. The geosphere reaches all the way down to Earth's center, not just the surface soil.
- _____ 2. Weathering and erosion are the exact same process.
- _____ 3. A landslide can link the atmosphere, hydrosphere, and geosphere within seconds.
- _____ 4. Meteorologists study rock layers to predict landslides.
- _____ 5. Ground sensors at Bingham Canyon gave workers enough warning to evacuate before the slope failed.

Fill in the Table

Use the article to complete the table below.

Earth System	What It Includes
Geosphere	
Hydrosphere	
Atmosphere	
Biosphere	

Critical Thinking

Using what you learned about the four Earth systems AND about fast versus slow change, explain how a single heavy storm could affect all four systems at once.

REFLECTION & TRANSFER



Use evidence from the article and examples from your own life to explain your thinking.

01

CONNECT



How might the four Earth systems show up in a single ordinary day at your house?

THINK ABOUT



Step 1: think of one thing you did today that involved water.

Step 2: think of one thing that involved the ground or dirt.

Step 3: think of one thing that involved air or weather.

02

APPLY



What would you do if you noticed a crack slowly growing wider in a sidewalk or wall near your home?

THINK ABOUT



Step 1: decide whether this looks like a slow change or a sudden one.

Step 2: name which Earth system is most likely involved.

Step 3: decide who you would tell about it and why.

03

DECIDE



If your county had enough money to hire only one new Earth scientist, which would you choose, and why?

THINK ABOUT



Step 1: list the five jobs from the Data Analysis table.

Step 2: think about which hazard or resource issue matters most where you live.

Step 3: pick the job that best matches that local need.

DATA ANALYSIS



Five Earth Science Occupations			
Job Title	What They Measure	Median Annual Pay	Projected Change in Jobs, 2024–2034 (%)
Hydrologist	Water in rivers, lakes, and underground	\$92,060	0%
Geoscientist	Rock layers and Earth processes	\$99,240	3%
Atmospheric Scientist (Meteorologist)	Temperature, wind, and storms in the atmosphere	\$97,450	1%
Surveying and Mapping Technician	Land features, boundaries, and elevation	\$51,940	5%
Emergency Management Director	Community hazard risk and readiness	\$86,130	3%

The table above uses the U.S. Bureau of Labor Statistics (BLS) Occupational Outlook Handbook, which publishes a median annual wage and a projected 2024–2034 employment change for each occupation named in the article.

Question 1 — READ IT

According to the table, what is the projected percent change in jobs for Surveying and Mapping Technicians, 2024–2034? _____

Question 2 — FIND THE PATTERN

Put the five jobs in order from fastest projected growth to slowest. Which job grows the fastest, and which grows the slowest?

1st (fastest): _____
2nd: _____
3rd: _____
4th: _____
5th (slowest): _____

Question 3 — EXPLAIN IT

Which of these five Earth science jobs would you recommend to someone who wants the strongest job growth over the next ten years?

Claim: _____

Evidence from the table: _____

Reasoning: _____

HYPOTHETICAL SCENARIOS

Read each hypothetical scenario carefully. Use evidence from the article and what you have learned to analyze the situation, solve the problem, and explain your reasoning.

Scenario 1: The Widening Crack

A school custodian notices a crack along the gym's foundation that has grown about 2 centimeters wider every month for a year. The district has enough money to fully repair only one building this year.

A. Is this an example of slow change or sudden change? Explain.

B. Which Earth system is most involved, and how might weathering or erosion be a cause?

C. If the crack keeps growing at this rate, what should the district do first, and why?

Scenario 2: Dry Summer Budget

A small town's leaders have money left in this year's budget for only one project: paying a hydrologist to check groundwater levels, or paving a new sidewalk.

A. What could a hydrologist tell the town about its water supply?

B. How might this choice affect families next summer if rain is scarce?

C. Which project would you fund, and what data would support your choice?

KEY TERMS



Write the definition of each term in your own words.

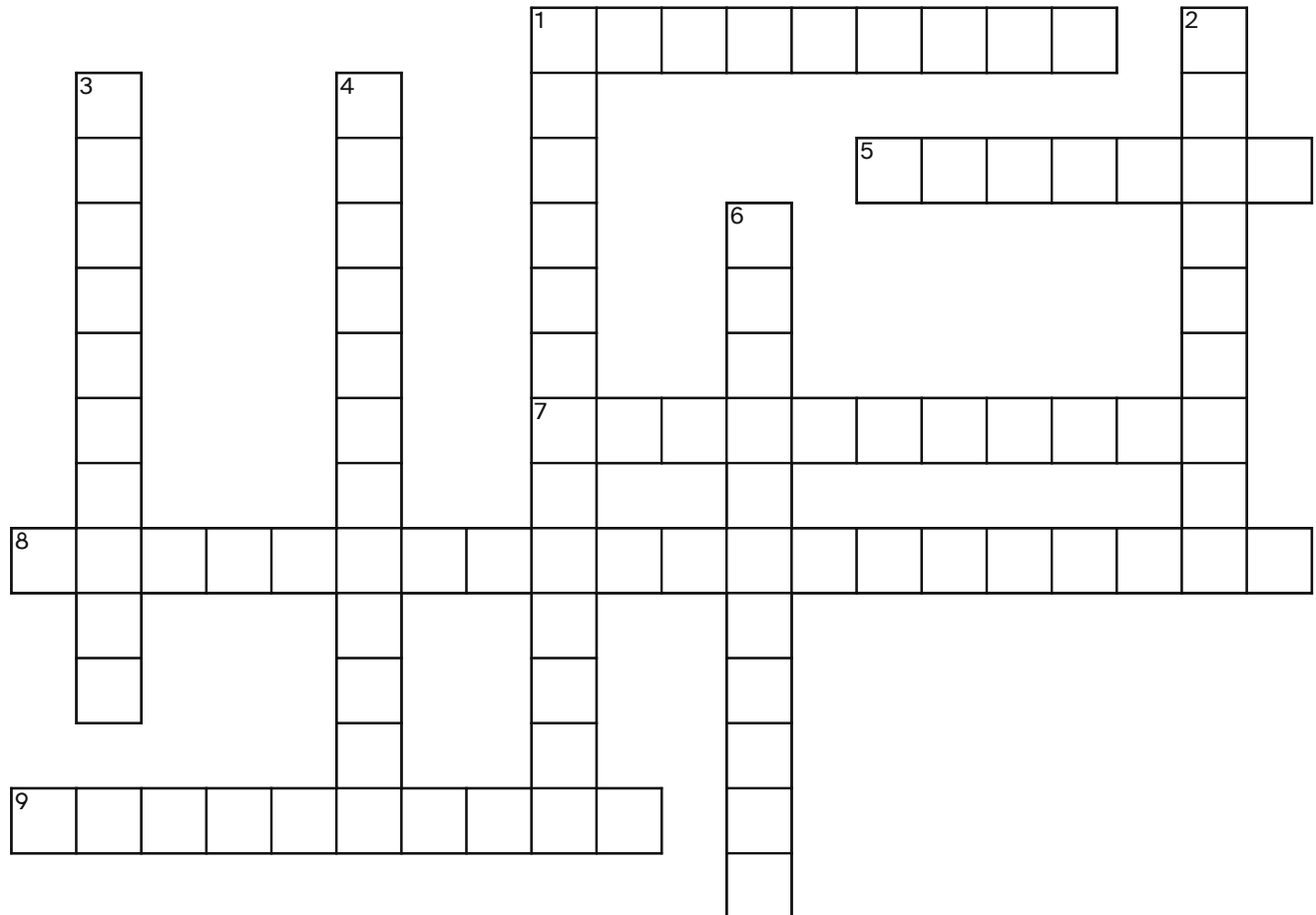
TERM	DEFINITION
Atmosphere	
Biosphere	
Erosion	
Geologic Time	
Geosphere	
Geotechnical Engineer	
GIS Technician	
Hydrologist	
Hydrosphere	
Weathering	

What Is Earth Science?

M A I D E E D R O E D E N A F P E R G L O S
 T G E O M T C I T T G H I W C S R G I V H A
 W R G E O L O G I C T I M E I H D I T L E E
 A E I M C I R E I Y M O N A T E T E E G H Y
 R S S R C I S S S N V H N T I E S M R I Y I
 R T T E N T E R I M S I G H I O I N M O D H
 Y G E O T E C H N I C A L E N G I N E E R Y
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 D E H E O D Y A E H E T E I L V O O L O L C
 I S N Y I P H E T T G A A N H I I G G S O M
 I A I S D H S S T D G T O G P E A C A I G B
 I A C N P R L M E T H R M U R T G S H O I E
 I E I R G G O C I A C M L S G L O S R N S R
 L I A L P E Y S T S A R P I B O R I R H T H
 L H N E B I O S P H E R E E H T T O W T I E
 H A E A T M O S P H E R E U O O N M S N O T
 N O L T G I O E P I E I O M H H O A S Y E Q
 S H H E R E O I O H A R N T E E S N E R E N
 N O H S L R H S I I E A E O I Y T N G E E M
 E E P S R O C E T E C R U T O D E H I I R H
 R D H U E O H O R D T C E R H O E E E C V E
 C A T E H O O S W I R E H O A S E I O D C A

ATMOSPHERE BIOSPHERE EROSION GEOLOGIC TIME
 GEOSPHERE GEOTECHNICAL ENGINEER GIS TECHNICIAN
 HYDROLOGIST HYDROSPHERE WEATHERING

What Is Earth Science?



ACROSS

- 1 Earth's solid ground and interior, reaching to the center
- 5 Movement of loose rock and soil to a different place
- 7 All water on Earth, from oceans and glaciers to groundwater and puddles
- 8 Professional who tests soil and rock before roads or buildings are built (2 words)
- 9 Slow breaking of rock into smaller pieces by wind and rain

DOWN

- 1 Worker who turns Earth-system data into maps for city planners (2 words)
- 2 Earth's layer containing every plant, animal, and person
- 3 Mix of gases surrounding Earth that people breathe
- 4 Earth's history measured in spans from thousands to millions of years (2 words)
- 6 Scientist who measures water in rivers, lakes, and underground stores