Earth's Changing Surface Teacher Masters: Table of Contents

Introductory Letter to Families

Teacher Masters

Family Links

2012 Edition

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Dear Families,

Our class is beginning the Science Companion® Earth's Changing Surface Unit. The Earth's Changing Surface Unit guides students through a hands-on exploration of the processes that shape the earth's surface and encourages them to build on their natural sense of wonder and curiosity about their world. As they observe, describe, and experiment, children hone their science process skills, as well as begin to discover the various landforms that shape the earth's surface and learn how they were created.

During the Earth's Changing Surface Unit, the students will:

- Discover that the earth's surface is constantly changing and that landforms are a result of those changes.
- Build models of rivers, glaciers, hoodoos, sand dunes, mountains, and volcanoes to demonstrate how water, wind, ice, and internal earth forces shape the earth's surface.
- Learn how weathering, erosion, and deposition break down, move, and build up the earth's surface, and explain how those processes create different landforms.
- Explore how abrasion breaks down rock.
- Develop ideas about how their local landscape features were formed and how they change through time.

You and your child can explore this rich topic together at home by:

- Reading geology-related science books together that your child checks out from the class Science Center or the local library.
- Visiting the web site at **www.ScienceCompanion.com** to find a list of recommended web sites about landforms and the processes that shape the earth's surface.
- Perusing the *Earth's Changing Surface Student Reference Book,* which provides readings, diagrams, photographs, and other resources designed to enhance your child's classroom learning.
- Working together on the **Family Link** activities and homework that are sent home from time to time. Your child may also want to repeat and vary some of the activities we do in class, as well as explain what they discovered and learned. Try to encourage their independent experimentation at home.

The Earth's Changing Surface unit will encourage students to develop a view of the earth's surface as dynamic and constantly changing. We hope the children will bring their discoveries and enthusiasm home, inviting you to learn alongside them—asking questions, discussing their work, and sharing their adventures in science.

Sincerely,

Surface Changes Walk

The first column of the table below lists places and changes you might look for around your school to identify changes to the surface of the earth. The second column lists some of the possible causes of these changes. These are only suggestions to help you plan your Surface Changes Walk; you will find interesting and unique changes for your location.

Change to Earth's Surface:	**Possible Cause of the Change:**
Disturbed earth under downspouts	Water
Worn places on steps	Human footsteps
Cracks in pavement	Plant roots, ice, water erosion
Loss of sand from a sandbox	Wind, water
Paths worn on grass lawn	Human and animal footsteps, water
Weathering of statues or buildings	Water, ice, wind
Construction work in the neighborhood	Humans
New or dried up puddles	Water, sun, heat
Animal burrows in the ground	Animals
Dead plants/bare soil	Absence of water
Wear and tear on playground equipment	Weathering, human use
Leaves, branches, or tree limbs on ground	Plants, wind
Animal feces on ground	Humans and their pets, wild animals
Landscaping (planted trees, mowed lawns, etc.)	Humans
Ant hills in dirt	Biological or animal
Drifts of snow or piles of leaves	Wind
Smooth or flat playing fields	Machinery
Dry tracks in mud, gullies near school	Water

Name: _____ **Date:** _____

Landform Information

The following table describes the visuals displayed in Lesson 2 and subsequent lessons. Use the notes provided to help guide students to observe carefully, name particular landforms, and explain and record their ideas about how the landforms were created. If you saw examples of similar landforms on the Surface Changes Walk, ask students to point out those similarities.

Teacher Note: You don't need to share all the information provided. It is more important to encourage students to make their own guess about how the landforms were created. As you teach the lessons, you can return to the transparencies to help students apply their new understanding to explain these features.

Landform 1	**Stream on Mt. Alyeska, Alaska**
Landform(s) displayed:	Stream: A body of flowing water that empties into an ocean, valley, lake, or river. Usually has less water than a river.
Questions for students:	• Is the water moving? How can they tell? • Is it fast or slow moving? Why might this matter? • Will this streambed always look the same? • What might change its shape?
How the landform was created:	Water runs down the slope of the mountainside, eroding rock and sediment and depositing this material.
Special details and features:	To provide a sense of scale, point out the smaller rocks and patches of melting snow.
Landform 2	**Great Smoky Mountain National Park, Tennessee and North Carolina**
Landform(s) displayed:	• River: A body of flowing water that empties into an ocean, valley, lake, or another river. • Students may also notice the mountainside in the background.
Questions for students:	• Other than water and trees, what natural substance makes up a large portion of this photograph? (*Rocks.*) • Were the rocks always there? If not, how did they move there? • Does this river always look the same? What would change it? • Can they guess where the water comes from?
How the landform was created:	This river was formed by the erosion of material, and deposition of rocks, boulders, and sediment after heavy floods. The mountains in the background are the original source of the rock.

Landform Information

Landform 3	**Aerial View of the Innoko River, Alaska**
Landform(s) displayed:	• River • Riverbank: The sides of a river.
Questions for students:	• How fast is the water flowing? How can you tell? • How does this compare to the stream in "Landform 1"? • Does the water move faster or slower? • Is the slope steep or flat?
How the landform was created:	This meandering river was created by water flowing at a slower rate through an almost flat plain. The path is determined by the slope of the landscape.
Landform 4	**Rio Grande River and Santa Elena Canyon, Texas**
Landform(s) displayed:	• Canyon: A deep valley with steep sides shaped by water. • River
Questions for students:	• What can they tell about the rock? (*Note the layers.*) • Why are the canyon walls so steep? • Why is the river water brown? (*It carries sediment.*)
How the landform was created:	This canyon was formed over a long time by weathering of rock, and erosion by the river's water.
Landform 5	**Red Canyon (with Grand Valley in the distance), Colorado**
Landform(s) displayed:	• Canyon • Valley: The low land that lies between mountains or hills.
Questions for students:	• What shaped this canyon? • Where is the water? Where could it come from?
How the landform was created:	This canyon was formed by the weathering of rock and the erosion of material by infrequent, seasonal rains. (There is no permanent stream in this arid region.)
Special details and features:	You might explain that this photo is taken from the top of a large mesa cut by the canyon. (A mesa is a flat, elevated area of land surrounded by steep sides.)

Name: _____ **Date:** _____

Landform Information

Landform 6	**Goblin Valley, Utah**
Landform(s) displayed:	• Hoodoo: A strangely-shaped rock formation, usually sculpted by wind erosion. • Mushroom rock: A rock formation that has a narrow base and a wide top. • Rock pillar: A tall column of rock. (A mushroom rock is a special type of rock pillar.)
Questions for students:	• Is the rock pillar solid rock? (*Yes.*) • What might have shaped this pillar? (*Water and wind.*) • How does the round rock on top of the pillar affect the rest of the mushroom rock's shape? (*For now, encourage students to guess; they discover the answer during the exploration in Lesson 7.*)
How the landform was created:	**Rock pillars** form when water and wind wear away rock and then transport the sediment until all that remains is a ragged rock column. Sometimes a **hard cap** as a kind of protective "hat" for the pillar, shielding the underlying layers of sediment from seasonal rains.
Special details and features:	Some students might notice that this formation is located in a canyon and that there are rock pillars in the middle distance.

Landform Information

Landform 7	**Cunningham Creek, San Juan Mountains, Colorado**
Landform(s) displayed:	• Creek: A small stream. Streams and rivers often have many tributary (side) creeks. • Mountain: A part of the earth's crust that has been raised high (at least 300 meters [985 feet]) above the surrounding lowlands. • U-shaped valley: A lowland area that was carved by a glacier and has a distinct rounded shape.
Questions for students:	• What is running down the middle of the valley? (*A creek and a road.*) • Does the creek appear to carry as much water as some of the rivers and streams in the previous pictures? • What else might have shaped this valley? • What caused the sides of this valley to be so round and smooth? • Why is the mountainside in the background so rocky? (*High elevation and steep sides make this a challenging habitat for trees.*)
How the landform was created:	The valley in the foreground was originally carved by a glacier. The creek does not carry enough water to have eroded the valley much since the glacier melted.
Special details and features:	Note the road was created by human activity, but may have once been a track used by animals.

Name: _____ **Date:** _____

Landform Information

Landform 8	**Mount Le Conte and Emerts Cove, Great Smoky Mountains National Park, Tennessee and North Carolina**
Landform(s) displayed:	• Mountains, river, and a valley
Questions for students:	• What is running down the middle of the valley? (*A creek and a road.*) • Does the creek appear to carry as much water as some of the rivers and streams in the previous pictures? • What else might have shaped this valley? (*Human activity has leveled the valley to make fields for crops.*) • What caused the mountaintops to be almost round? • Why might it be easier for trees to grow on these mountains? (*Lower elevation and less steep sides make this a good habitat for trees.*)
How the landform was created:	Like the rest of the Appalachian range, these mountains are "old." Their round shape is due to millions of years of weathering and erosion of rock material.
Special details and features:	Trees grow because it is at a low elevation and the rounded slopes can hold a lot of soil and small plants that build even more soil.

Landform Information

Landform 9	**Aerial view of Mt. St. Helens, Washington, after the May 18, 1980 eruption**
Landform(s) displayed:	• Volcanic mountain: A mountain formed by the deposition and accumulation of volcanic materials over time.
Questions for students:	• What feature is at the top of the mountain? (*A crater.*) • What can they see that shows that there was a sudden, dramatic change? (*Students may notice the barren landscape and mudslides [lahars] in the lower foreground of the photo.*) • What might this mountain have looked like before the eruption?
How the landform was created:	This volcano built up until internal earth forces caused an eruption in 1980.
Special details and features:	For web sites with detailed information about the spectacular eruption in 1980, as well as the current status of Mt. St. Helens, visit our web site: **www.sciencecompanion.com/links/**.
Landform 10	**Alaska Peninsula National Wildlife Refuge, Alaska**
Landform(s) displayed:	• Glaciers: Large, long-lasting masses of moving ice and snow. Glaciers move downhill or outward in all directions as a result of gravity and their immense weight. • Mountains, river, and a U-shaped valley
Questions for students:	• What created the steep slope of the mountainsides? (*The slopes are one side of a U-shaped valley carved by a glacier that melted.*) • Where is the source of the river's water? • Why does the riverbed seem so broad and wide when there is so little water? (*During spring floods more water flows, eroding material and changing the river's course over this relatively flat valley floor.*)
How the landform was created:	This broad, U-shaped valley lies alongside a mountain range created by internal earth forces. Because of the high latitude, snow does not melt in summer and glaciers form on the mountaintops, providing the river's water. During the last Ice Age, the valley itself would have been filled by a large glacier.

Name: _____ **Date:** _____

Landform Information

Landform 11	**Kilauea Point National Wildlife Refuge, Hawaii**
Landform(s) displayed:	• Beach: Land at the edge of a body of water, usually marked by sand or gravel that has been deposited by waves. • Cliff: A high, steep surface of rock.
Questions for students:	• What is the water in this photo doing? • How did the beach form? • What details can they see in the cliff? (*Layers of rock*.) • What caused these layers? • How did the cliff form?
How the landform was created:	The layers of rock were deposited by many eruptions of a volcano. The cliff was created as water from rain and waves weathered and eroded the rock. The beach was formed from sediment deposited by waves.
Special details and features:	Point out the layers in the cliff formations and compare these to the layers in the canyon shown on Teacher Master "Landform 4."
Landform 12	**Sand ripples on the shoreline of a lake below Spencer Glacier, Alaska**
Landform(s) displayed:	• Sand ripples: Wave-like patterns that form on the surface of sand. The patterns move and shift due to changing water or wind currents.
Questions for students:	• Other than sand, what can they see in the photo? (*Plant roots and rocks*.) • Where could this sand have come from?
How the landform was created:	As water advances and retreats over the sand, small dunes are deposited by the waves. The sand originated from rock weathered by glaciers and water.
Special details and features:	Compare the tiny dunes in this photo with the large dunes in the next one.

Landform Information

Landform 13	**Namib Desert Dunes, Namibia, Africa**
Landform(s) displayed:	• Sand dune: A hill or ridge of loose sand formed by the wind.
Questions for students:	• What is this formation made of? (*Sand.*) • Where could the sand come from? (*Weathered rock.*) • How did it get here? (*It was moved by wind.*) • What might shape the dune? (*Wind, and if water is present, rain.*) • How might the plants affect the way a dune changes over time?
How the landform was created:	Sediment broken down in the southern African highlands washes down the Orange River and into the Atlantic Ocean. Currents carry the sediment north, where it is deposited along beaches. The prevailing winds carry the sand inland and create a vast area of huge dunes.
Special details and features:	Point out the sand ripples in the foreground (bottom of photo) of the dune. Compare these to the ones in the previous photo and have students think about the different forces (water and wind) that created them.

Name: _____ **Date:** _____

Landform Information

Landform 14	View from space of the Great Lakes, North America
Landform(s) displayed:	• Lake: A body of fresh water.
Questions for students:	• What can they see in the photo? (*Land, lakes, pack ice, and snow.*) • Are these landforms? (*The lakes and surrounding land are landforms; the pack ice and snow are not.*) • What will happen to the snow and pack ice when summer comes? (*They will melt.*) • How might this impact the surface of the earth? (*Water impacts the earth's surface in many ways that students will learn about in future lessons.*) • Why did we need to use a satellite photo to show these landforms? (*Some landforms are so large that they can only be distinguished in their entirety from a great distance.*)
How the landform was created:	The Great Lakes were formed as glaciers scraped the earth's surface during the last Ice Age. At its greatest extent, 18,000 years ago, the ice sheet was up to 4 km (2.5 miles) thick. As the ice melted and receded starting about 14,000 years ago, the lakes began to form from the glacial meltwater.
Special details and features:	• The lakes depicted, from top to bottom (east to west), are: Lake Ontario, Lake Erie, Lake Huron, Lake Michigan, and Lake Superior. • This image was taken by NASA's Aqua satellite, in orbit around the Earth. According to NASA, the red dots on the photo indicate the location of thermal activity, such as a fire or other human activity, detected by the satellite's instruments. • If you have one available, refer to a map of North America to provide context for students to place these features and comprehend their size. • Point out the smaller Finger Lakes of western New York State, just below and to the right of the title. (*These were also created by glaciers.*)

Name: _____ **Date:** _____

Landform—Sensory Memories

To help you describe your landform with more details, close your eyes and think about the setting of your poem, legend, or story. Then open your eyes and jot down notes in the proper places below. Use these details when you write.

What the place looked like:

What it smelled like:

What sounds I heard:

What I touched or tasted:

What did those things feel or taste like?

How I felt about this place and experience:

Name: _____ **Date:** _____

Glacial Movements

The Kutiah Glacier in Pakistan holds the record for the fastest glacial movement. In 1953, it advanced more than 12 km (7 miles) in three months (90 days). That's the length of over 100 football fields! Assuming the glacier traveled exactly 12 km, how many meters (m) did it travel each day? Show your work in the space below.

Remember that 1 km = 1000 meters.

_____ km x 1000 m = _____ m

_____ m ÷ 90 days = _____ m per day

Processes that Shape the Earth's Surface

As students assess each area for evidence of change, prompt them to reflect on what they've learned so far in the unit about the ways that water, wind, ice, humans, plants, and animals can shape the earth's surface. Guide their thinking by asking the following questions:

1. What evidence of erosion do they see? (See possible examples below.)
    - Small gullies
    - Holes under downspouts
    - Holes in the ground

2. What evidence of deposition do they see? (See possible examples below.)
    - Mounds of dirt
    - Dirt on sidewalks
    - Ant or mole hills

3. What evidence of weathering do they see? (See possible examples below.)
    - Broken asphalt or concrete
    - Broken rocks
    - Worn playground equipment
    - Plants growing on or through concrete or rocks

Request for Materials

Dear Families,

Next week in science class we will be performing an exploration that requires the following materials:

If you can donate or lend any of these items, please send them in with your child

by _____.

(requested date)

Thank you for your support,

_____

Name: _____ **Date:** _____

The Shaping of Bryce Canyon

This teacher master is intended to help you guide students' thinking as they embark on their virtual field trip of Bryce Canyon National Park.

Weathering	Erosion	Deposition
Card 1: These pinnacles provide evidence of weathering most likely due to abrasion from water and wind.	**Card 1:** The sediment from the abrasion that formed these pinnacles has been eroded by water and wind.	**Card 1:** The rock that formed these pinnacles was originally deposited as sediment in a large inland sea.
Card 2: This narrow canyon shows evidence of abrasion due to the action of water and wind.	**Card 2:** The sediment from the abrasion that formed this canyon has been eroded by water and wind.	**Card 2:** The rock that formed this canyon was originally deposited as sediment in a large inland sea.
Card 3: The road at the top left corner shows evidence of weathering due to human impact.	**Card 3:** The mud in the river reveals sediment that has been eroded from upstream.	**Card 3:** Not applicable.
Card 4: This rock arch has been carved by abrasion due to moving water and wind.	**Card 4:** The sediment resulting from the abrasion that formed this arch has been eroded away.	**Card 4:** The rock that formed this arch was originally deposited as sediment in a large inland sea.
Card 5: These formations have been carved by abrasion from moving water and wind. The differing shapes of the rocks in the spires are due to differences in the resistance to erosion of the rocks.	**Card 5:** The sediment resulting from the abrasion that created these landforms has been eroded away.	**Card 5:** Not applicable.

The Shaping of Mt. St. Helens

This teacher master should help you guide students' critical thinking as they embark on their virtual field trip of the cataclysmic volcanic eruption that shaped Mt. St. Helens and its surroundings. The information in the table below is not meant to be exhaustive. It is intended to help you and the students observe and describe the major ways the mountain changed in a very short time.

Photo Card	Description	Causes or Evidence of Change
1	Mt. St. Helens prior to its eruption on May 18, 1980. Note the symmetrical cone-shaped profile of the mountain.	Because of the amount of snowfall and glaciation on the mountain, it was mainly subject to weathering, erosion, and deposition due to the movement of water (rain and melting snow) and ice (glaciers).
2	Volcanic ash plume rising above the summit of Mt. St. Helens during the eruption of May 18, 1980. Note the dark layers covering the mountain, which are volcanic ash, and the white material, which is snow and glacial ice.	The eruption occurred as a result of intense forces originating inside the earth. The ash plume was caused by the very high gas content of the magma, which created explosive eruptions. Most of the ash, after being blown east by prevailing winds, eventually was deposited on the surface of the earth as far as 500 miles away.
3	The same view of the mountain as photo card 1, but taken after the eruption. Note the difference in elevation between the top of the volcano shown in photo card 1 (9,677 ft) and the summit shown in this photograph (8,363ft).	This photo card is most instructive when compared with photo card 1. Draw attention to the large crater, the massive change in shape of the mountain, the steam rising from the crater, and the destruction of the forest.

Name: _____ Date: _____

The Shaping of Mt. St. Helens

Photo Card	Description	Causes or Evidence of Change
4	Cooled pumice flow deposited on side of mountain.	The pumice in this photo card reveals a great example of how the surface of a mountain can be changed due to deposition of rock after a volcanic eruption.
5	Car buried by volcanic ash.	As the ash plume settled to the ground, it changed the surface of the earth over a huge area.
6	Vegetation growing again on the mountain. Note the crater, ash, and the volcanic dome inside the crater.	This photo card shows that after all the devastation of a huge volcanic eruption, new changes occur in a short time.

Name: _____ **Date:** _____

Family Link with Science—Home Activity

Building Sand Castles

Materials:

- Pebbles
- Mulch
- Rocks, sand, or soil
- Any other available material

Directions:

1. Build a "sand" castle out of the materials available in your yard. You can also build at a neighborhood park or other area that won't be disturbed by other children.
2. Make a drawing of the "sand" castle as it appears when you first build it. Draw this on the back of this sheet.
3. Record your predictions about how the castle might change over time:

4. What might be the likely cause or causes of the changes?

5. Check the castle every week to track changes. If possible, make sketches or use a camera to record the changes that occur and bring the drawings or photographs to class to put in the Science Center.

This activity is optional.

Name: _____ **Date:** _____

Family Link with Science—Home Activity

Rock Hunt

Go on a rock hunt with a family member. Try to find at least one smooth rock and one rough rock in your local environment.

1. Where did you find your smooth rock? _____
2. Describe what the area looks like:

3. What do you think caused its smooth appearance? Why?

4. Where did you find your rough rock? _____
5. Describe what the area looks like:

6. What do you think caused its rough appearance? Why?

This activity is optional.

Name: _____ **Date:** _____

Family Link with Science—Home Activity

Experiencing the Depression Era Dust Bowl

Directions:

1. Ask a family member if they remember the Dust Bowl in the American Midwest during the 1930s.
2. If no one in your family experienced the Dust Bowl, ask if they remember a drought that occurred in some other region or if anyone remembers stories about the Dust Bowl that were told to them by a parent or grandparent.
3. Learn more about the Depression Era Dust Bowl in America by exploring web sites together that discuss this topic. You can find links to related sites by visiting **www.sciencecompanion.com/links**.

This activity is optional.