The Effects of Constructive and Destructive Forces

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Unit Overview

During this three-week, flipped classroom unit, students investigate how constructive and destructive forces constantly change the Earth's surface, and how scientists attempt to control these forces' effects through tools and human intervention. Through Lego construction, video creation, group discussion, and hands-on activities, students learn how deposition, earthquakes, volcanoes, weathering, and erosion can build or destroy the Earth's surface. The unit concludes with students predicting and attempting constructive and destructive forces, and debating the advantages and disadvantages of human intervention and technology.

Standards Addressed

1. **S.5.E.1a:** Students will identify surface features of the Earth caused by constructive processes, including depositions, earthquakes, volcanoes, and faults.

2. **S.5.E.1b:** Students will identify surface features of the Earth caused by destructive processes, including erosion, weathering, the impact of organisms, earthquakes, and volcanoes.

3. **S.5.E.1c:** Relate the role of technology and human intervention in the control of constructive and destructive processes, including seismological studies, flood control, and beach reclamation.

Day 1 – Introduction and Lego Building

Standards Addressed: 1, 2

Objective: Scientists will be able to differentiate between constructive and destructive forces.

1. *Flipped Portion:* Prior to the lesson, provide the students with a video about constructive and destructive forces. The video should discuss: (a) that the Earth's surface constantly changes, (b) how constructive forces are building the Earth's surface, and (c) how destructive forces are destroying the Earth's surface. Provide students with guided notes to complete while viewing the video.

2. Provide each student with ten Lego pieces and instruct them to *build something*. Allow for students to use their imaginations and creativity.

3. In pair-share partners, have students reflect on their observations as they built the Lego structures. Then, lead a sharing out as a whole group. Attempt to lead the students to understanding how the structure became taller and larger as they continued to add Lego pieces.

4. In pair-share partners, have students discuss whether or not this process is constructive or destructive. To facilitate conversation, have the first partner decide if the action is a constructive or destructive force and the other partner reflect on whether he or she agrees or disagrees and explain why or why not. Encourage the students to cite evidence from their guided notes when providing a rationale.

5. Instruct students to take apart their Lego structures. Within their pair-share partners, have them discuss their observations during the disassembly. Then, lead a sharing out as a whole group. Attempt to lead the students to understanding how the structure became smaller as they subtracted Lego pieces.

6. In pair-share partners, have students discuss whether or not this process is constructive or destructive, in the same manner as step number 4.

7. Transition the students into groupings based on their Lexile scores. Provide them with an article about constructive and destructive forces. While reading the article, have students complete a Venn Diagram about the similarities and differences between the forces.

8. To end the lesson, provide each student with an unlabeled example of a constructive or destructive force. Consider having the class provide answers through smart clickers or other technology. Then, allow time for the students to discuss their findings in pair-share partners and as a large group.

Day 2 – Toontastic Volcanoes

Standards Addressed: 1, 2

Objective: Scientists will be able to explain how volcanoes are both a constructive and destructive force.

1. *Flipped Portion:* Prior to the lesson, provide students with a video about the relationship between constructive and destructive forces and volcanoes. The video should discuss: (a) how the Earth's surface is constantly changing and (b) how and why volcanoes are constructive (e.g., building islands) and destructive (e.g., burning crops). Provide students with guided notes to complete while viewing the video.

2. As a large group, lead a review with the students about how volcanoes form. Include the following key points:
    - Volcanoes are created when tectonic plates pull apart;
    - Magma is found underneath the earth's crust; and
    - When lava reaches the Earth's surface it is called magma.

3. In pair-share partners, have students discuss, based on their understanding of the video, how volcanoes are constructive and destructive forces. Then, lead a whole group discussion on their observations. Consider compiling the student answers using technology, such as a Smart Board, Edmodo, or Google Classroom.

4. Instruct students that they will create a digital storybook to demonstrate their understanding of how volcanoes are constructive and destructive forces. Ensure that they understand the criteria for a successful story, including that the story MUST:
    - Include at least two characters;
    - Explain how volcanoes are formed;
    - Define constructive and destructive processes;
    - Include two ways that volcanoes are constructive; and
    - Include two ways that volcanoes are destructive.

5. In pair-share partners, lead the students to create a storyboard to demonstrate their understanding of how volcanoes are constructive and destructive forces. After the storyboard is complete, instruct the students to use a digital storytelling platform, such as the iOS app Toontastic.

6. Have students share their digital artifacts with each other.

Day 3 – Create an Earthquake Commercial

Standards Addressed: 1, 2

Objective: Scientists will be able to create a commercial describing how earthquakes are constructive and destructive forces.

1. *Flipped Portion:* Prior to the lesson, provide students with a video about the relationship between constructive and destructive forces and earthquakes. The video should discuss: (a) how the Earth's surface is constantly changing and (b) how and why earthquakes are constructive (e.g., creating landforms) and destructive (e.g., causing landslides, mudslides, and faults). Provide students with guided notes to complete while viewing the video.

2. As a large group, lead a review with the students about the relationship between forces and earthquakes. Include the following key points:
    - Earthquakes occur when two tectonic plates slide past each other and energy is released suddenly;
    - Earthquakes create cracks in the Earth's surface called faults;
    - The place where the energy is released from is the focus;
    - The epicenter is the point of the Earth's surface directly above the crust; and
    - The magnitude is the strength of the earthquake or the amount of energy released.

3. In pair-share partners, have students reflect on how earthquakes are constructive and destructive forces. Instruct students that each partner should provide specific examples of both forces. Then, as a large group, have students share out their findings.

4. Divide students into groups of three to four with heterogeneous ability levels. Instruct students to create a commercial that informs people how earthquakes are constructive and destructive forces. Ensure that they understand the criteria for a successful commercial, including that the commercial MUST:
    - Be at least 30 seconds long;
    - Include every group member speaking;
    - Explain the parts of an earthquake and how it occurs;
    - Define constructive and destructive forces; and
    - Provide two examples of how earthquakes can be constructive and destructive forces.

5. Start the groups off by having them create a script for the commercial.

6. Upon the completion of the script, allow students to film the commercials using technology, such as a digital camera or iOS application (e.g., Vimo). Once the students have completed their commercials, have them share their digital artifacts as a large group.

Day 4 – Create a Job Posting for a Seismologist

Standards Addressed: 3

Objective: Scientists will be able to explain a seismologist's roles and differentiate between the tools used by a seismologist.

1. *Flipped Portion:* Prior to the lesson, provide students with a video about how scientists study earthquakes. Provide students with guided notes to complete while viewing the video. The video should discuss the following points:

- A seismologist is a person that studies or monitors the movements of the Earth's crust;
- Seismologists predict the occurrence of an earthquake;
- Seismologists study the effects of an earthquake;
- Seismographs are instruments that detect movement of the Earth's surface or seismic waves;
- A seismogram is the printout from the seismograph that allows a seismologist to determine the earthquake's magnitude; and
- Seismograms allow scientists to determine how strong an earthquake is according to the Richter Scale.

2. In pair-share partners, have students reflect on their knowledge of seismologists, seismographs, and the meaning of the root word *seismos* – a Greek root word that means earthquake. Then, lead a large group in sharing out their findings.

3. Divide the class into the same groups of three to four from the previous lesson. Instruct the groups to create a classified job advertisement for a seismologist, using poster board or chart paper.

4. Ensure students understand the criteria of a successful advertisement, including that the advertisement MUST:
    - Explain the roles of a seismologist;
    - List and describe the two tools a seismologist uses;
    - Describe how the two tools differ from each other; and
    - Explain the Richter Scale.

5. Once the students have completed their advertisements, have them present their artifacts to the large group.

Day 5 – Kahoot! Review

Standards Addressed: 3

Objective: Scientists will be able to demonstrate knowledge of the destructive and constructive effects of volcanoes and earthquakes, and how scientists predict the occurrence of earthquakes, using Kahoot.

1. In advance of the lesson, create an appropriate Kahoot review from the following address: https://getkahoot.com.

2. Distribute technology to the class. Instruct students to visit the following address: https://kahoot.it.

3. Upon starting the game, allow for the students to work through each question for one minute.

4. After the game is complete, review the questions as a whole group. Facilitate a conversation with students about the five tips for success when answering questions:
    - Read the following statements at least two times.
    - Circle the key words in each question/statement. Circle no more than four key words.
    - Eliminate the answers you know are incorrect answers. *Lead students to explain why they are eliminating answers.*
    - Circle the correct answer.
    - Review your answer.

Day 6 – Weathering Using the Frayer Model

Standards Addressed: 2

Objective: Scientists will be able to explain how and why weathering is a destructive force.

1. *Flipped Portion:* Prior to the lesson, provide students with a video about how weathering is a destructive force. The video should explain that: (a) weathering is a destructive force and (b) weathering is the breaking down of sediment, and (c) that sediment is broken down rock. Provide students with guided notes to complete while viewing the video.

2. Guide students to complete the Frayer Model:
    a. In pair-share partners, have the students discuss the definition of weathering.
    b. Discuss the definition as a whole group.
    c. In pair-share partners, have the students discuss examples of weathering.
    d. Discuss examples as a whole group (e.g., cracks in a sidewalk).
    e. As a large group, review the definition of a *simile*. Then, in pair-share partners, have the students discuss a *simile* for weathering
    f. As a large group, discuss the *similes* that students developed.
    g. Instruct students to independently create their own examples and non-examples of weathering.

3. Instruct the students to independently complete a weathering is destructive writing activity. Then, as a whole group, discuss the reasons why weathering is destructive.

4. To end the lesson, have the students complete an exit ticket about weathering.

Day 7 – A Puppet Show About Weathering

Standards Addressed: 2

Objective: Scientists will be able to compare and contrast biological, chemical, and physical weathering.

1. *Flipped Portion:* Prior to the lesson, provide students with a video about how volcanoes are constructive and destructive forces. Provide students with guided notes to complete while viewing the video. The video should discuss the following:
    - Physical, biological, and chemical weathering breaks down rock into sediment;
    - Physical or mechanical weathering is the breaking down of rock without changing its chemical composition;
    - Physical or mechanical weathering is caused by water, temperature, animals, and wind;
    - Biological weathering is the breaking down of rocks by plants;
    - The cause of biological weathering is plants;
    - Chemical weathering is the breaking down of rock by changing its chemical makeup; and
    - The causes of chemical weathering are water and chemical reactions.

2. In pair-share partners, have the students discuss the similarities and differences between physical, biological, and chemical weathering. Then, discuss the answers as a large group.

3. In groups of three to four students, instruct the class to create a digital puppet show that compares and contrasts physical, biological, and chemical weathering. Consider using the iOS app Sock Puppets.

4. Ensure students understand the criteria for a successful puppet show, including that the sock puppet movie MUST include:
    - The definition of physical, chemical and biological weathering;
    - At least one similarity between physical and biological weathering;
    - At least one similarity between physical and chemical weathering;
    - At least one similarity between physical and chemical weathering;
    - At least one similarity between physical, biological, and chemical weathering; and
    - One fact that makes each of the following different – physical/mechanical weathering, biological weathering, and chemical weathering

    In addition, the movie MUST:
    - Be no more than two minutes;

- Include at least two characters; and
- Include participation from every group member.

6. Once the students have completed their movies, have them present their artifacts to the large group.

Day 8 – The Weathering Detective

Standards Addressed: 2

Objective: Scientists will be able to differentiate between examples of physical, biological, and chemical weathering.

1. *Flipped Portion:* Prior to the lesson, provide students with a video about differentiating between the types of weathering. Provide students with guided notes to complete while viewing the video. The video should discuss the following:
   - Signs of physical weathering include large cracks, large holes, and color changes;
   - Signs of biological weathering include rocks or holes, with plants growing from within; and
   - Signs of chemical weathering include small holes and color changes.

2. In pair-share partners, have students discuss the signs that show physical weathering has occurred. Then, discuss the answers as a large group. Repeat this pattern for biological weathering and chemical weathering.

3. In pair-share partners, have the students complete questions one through three from the **Weathering Detective Activity Sheet**. Then, have students work independently on questions four through six.

Day 9 – Real World Weathering

Standards Addressed: 2

Objective: Scientists will be able to distinguish between physical, biological, and chemical weathering from real word examples.

1. Facilitate a review about the signs of physical, biological, and chemical weathering.

2. Divide the class into groups of three to four students. Organize a trip to the school courtyard, playground, or open space to show real-world examples of weathering.

3. Distribute technology to the groups. Then, instruct the students to take pictures of weathering using the iOS application Chatterpix.

4. Ensure students understand the criteria for a successful final product, including that the final product MUST:
    - Contain at least three examples of physical, biological, and chemical weathering;
    - Be labeled with the appropriate weathering type;
    - Explain the observations that led the groups to decide which type of weathering had occurred; and
    - Provide an explanation for each type of weathering.

Day 10 – Erosion Using the Frayer Model

Standards Addressed: 2

Objective: Scientists will be able to define erosion, describe the four causes of erosion, and identify an example of erosion.

1. *Flipped Portion:* Prior to the lesson, provide students with a video about erosion. Provide students with guided notes to complete while viewing the video. The video should discuss the following:
    - Signs showing that erosion is a destructive process;
    - Explanation that erosion is the movement of sediment from one place to another;
    - Explanation that erosion can be a slow or quick process; and
    - Explanation that erosion is caused by water, gravity, ice, and wind.

2. Guide students to complete the Frayer Model:
    a. In pair-share partners, have the students discuss the definition of erosion.
    b. Discuss the definition as a large group.
    c. In pair-share partners, have the students discuss examples of erosion.
    d. Discuss the examples as a large group (e.g., the Grand Canyon).
    e. In pair-share partners, have the students discuss a *simile* for erosion.
    f. Discuss the *similes* developed by the students as whole group.
    g. Have the students independently draw an example and non-example of erosion.

3. Direct the students to work in pair-share partners to create a 3-2-1 summary. Include a criteria for success, including that the summary MUST contain:
    - **Three** causes of erosion;
    - **Two** landforms formed by erosion; and
    - **One** definition of erosion.

Day 11 – Deposition Using the Frayer Model

Standards Addressed: 1

Objective: Scientists will be able to define and identify surface features caused by deposition.

1. *Flipped Portion:* Prior to the lesson, provide students with a video about deposition. Provide students with guided notes to complete while viewing the video. The video should discuss the following:
    - Deposition is a constructive process.
    - Deposition is a dropping off of sediment to a new location.
    - Deposition is caused by water and wind.
    - The process of deposition forms deltas and sand dunes.

2. Guide students to complete the Frayer Model:
    a. In pair-share partners, have the students discuss the definition of deposition.
    b. Discuss the definition as a large group.
    c. In pair-share partners, have the students discuss examples of deposition.
    d. Discuss the examples as a large group (e.g., the Mississippi Delta).
    e. In pair-share partners, have the students discuss a *simile* for deposition
    f. Discuss the *similes* developed by the students as whole group.
    g. Have the students independently draw an example and non-example of deposition.

3. In pair-share partners, have students create a comic that explains deposition and the difference between a delta and a sand dune. Lead the students to create a storyboard. After the storyboard is complete, instruct the students to use a digital storytelling platform, such as the iOS app Toontastic.

4. Ensure students understand the criteria for a successful comic, including that the storyboard MUST:
    - Include the definition of deposition;
    - Show two landforms formed by deposition;
    - Identify the differences between sand dunes and deltas, and
    - Include each person's voice.

5. Once the students have completed their comics, have them share and present their artifacts to the large group.

Day 12 – Weathering, Erosion, and Deposition Detective Work

Standards Addressed: 1, 2

Objective: Scientists will be able to differentiate between examples of weathering, erosion, and deposition.

1. In small groups, have the students identify the causes of weathering. Then, discuss the answers as a large group (e.g., water, temperature, ice, plants, animals, and wind). Repeat this pattern for erosion (e.g., water, wind, ice, and gravity) and deposition (e.g., water and wind).

2. In small groups, have the students identify the results of weathering. Then, discuss the answers as a large group (e.g., breaking, wearing down, cave-formations, and cracking). Repeat this pattern for erosion (e.g., carrying away, moving mudslides, and landslides) and deposition (e.g., dropping off, deposit, delta, sand dune, and layers of sediment).

3. Complete the sorting activity, Weathering, Erosion, and Deposition, by Lauren Candler.
    - For each statement make sure that the students walk through all of the WED Detective Steps.
    - Complete numbers 1-4 as a whole group.
    - Assign for the students to complete numbers 4-8 with a pair-share partner.
    - Review numbers 4-8 as a large group.
    - Assign for the students to independently complete numbers 9-16.

Day 13 – Justifying Human Intervention

Standards Addressed: 3

Objective: Scientists will be able to justify the use of technology and human interventions when they were used to prevent situations where destructive and constructive processes occurred.

1. *Flipped Portion:* Prior to the lesson, provide students with a video about applying human intervention to control constructive and destructive forces. Provide students with guided notes to complete while viewing the video. The video should discuss the following:
    - Beach reclamation is the process of repairing a beach after it has been eroded or destroyed.
    - Beach reclamation does not stop erosion from occurring.
    - Dams control or stop the flow of water downstream and prevent flooding.
    - Jetties are wall-like structure made of stone that stick out into the ocean, preventing the beach from being eroded by ocean waves.

- Levees are wall-like structures made of earth or concrete that prevent water from flowing to certain areas.
- Seismological studies allow scientists to predict the magnitude of an earthquake.

2. In pair-share partners, have the students discuss how scientists can prevent the effects of flooding. Then, lead the discussion as a large group. Be sure to include the following key points:
    - Scientists create dams to control and redirect the flow of water downstream and prevent flooding of rivers.
    - Scientists create levees made of earth or concrete to prevent water from flowing to certain areas and prevent flooding.

3. In pair-share partners, have the students discuss how scientists can prevent beach erosion. Then, lead the discussion as a large group. Be sure to include the following key points:
    - Scientist use jetties to prevent the beach from being eroded by ocean waves.
    - Scientist use the process of beach reclamation to reverse the effects of beach erosion.

4. Instruct the students to complete the **Human Intervention Justifier Graphic Organizer.** Facilitate a discussion about number one as a large group. Then, assign the remaining content for students to complete in pair-share partners or independently, as appropriate.

Day 14 – Pros and Cons of Human Intervention

Standards Addressed: 3

Objective: Scientists will be able to explain how scientists can be flawed when attempting to control destructive and constructive processes.

1. As a large group, review the use of dams, jetties, levees, beach reclamation projects, and seismological studies.

2. In pair-share partners, have the students listen to a radio broadcast, watch a news video, and read articles that describe when dams, jetties, levees, and beach reclamation were not effective.
    - Beach Reclamation
    - Dam
    - Levee

3. After attending to each link, instruct the students to work with a pair-share partner to complete pros and cons of each form of human intervention on **Human Intervention Pros and Cons Graphic Organizer.**

Day 15 – Pros and Cons of Human Intervention

Standards Addressed: 1, 2, 3

Objective: Scientists will be able to rotate through multiple stations to practice and reinforce constructive and destructive processes.

Essential Question: How do scientists predict or attempt to alter the effects of constructive and destructive forces?

Station	Materials Needed	Description
Technology	• iPad	Scholars visit Quizlet study set and play vocabulary games Scatter or Test: https://quizlet.com/95961474/earth-science-vocab-flash-cards/
Hands On Activity	• Plates • Cookies • **Cookie Crumbling Activity Sheet**	1. Students will have to demonstrate weathering, erosion, and deposition using a cookie: • Weathering - break cookie into crumbs • Erosion - moving cookie towards mouth • Deposition - dropping crumbs in mouth 2. Students complete **Cookie Crumbling Activity Sheet**
Creativity – My Weathering, Erosion, and Deposition Book	• Manila Folders • Scissors • Glue Marker • **WED Activity Sheet**	Criteria for Success: Must Have: • Decorated cover with three drawings (one of weathering, erosion, and deposition); • Each force must have its own page; • Correctly define weathering, erosion, and deposition; • Correctly identify six examples of weathering; erosion, and deposition; and • Each example shows WED Detective Steps.
Gaming	• Laptop	Scholars will play Pac Man- Earth Science Review Game: http://www.classtools.net/pac/201510_Me7M2J