Topographic Maps and Land Features

Lesson Synopsis:

In this lesson, students will learn to interpret topographic maps and satellite views to identify land and erosional features, and predict how these features may be reshaped by weathering. Students will construct a model of a land feature, demonstrate how the feature was formed, and predict how it may change over time. The advantages and limitations of the model will be evaluated by the student. This is the first time topographic maps are specifically addressed.

TEKS:

8.9	***Earth and space. The student knows that natural events can impact Earth systems. The student is expected to:***
8.9C	**Interpret topographic maps and satellite views to identify land and erosional features and predict how these features may be reshaped by weathering. *Readiness Standard***

Scientific Process TEKS:

8.2	***Scientific investigation and reasoning. The student uses scientific inquiry methods during laboratory and field investigations. The student is expected to:***
8.2E	**Analyze data to formulate reasonable explanations, communicate valid conclusions supported by the data, and predict trends.**
8.3	***Scientific investigation and reasoning. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions and knows the contributions of relevant scientists. The student is expected to:***
8.3B	**Use models to represent aspects of the natural world such as an atom or a molecule, space, or a geologic feature.**
8.3C	**Identify advantages and limitations of models such as size, scale, properties, and materials**
8.4	***Scientific investigation and reasoning. The student knows how to use a variety of tools and safety equipment to conduct science inquiry. The student is expected to:***
8.4A	**Use appropriate tools to collect, record, and analyze information, including lab journals/notebooks, ~~beakers,~~ meter sticks, graduated cylinders, ~~anemometers, psychrometers, hot plates, test tubes, spring scales, balances, microscopes, thermometers, calculators, computers, spectroscopes~~, ~~timing devices~~, and other equipment as needed to teach the curriculum.**

GETTING READY FOR INSTRUCTION

Performance Indicator(s):

- Choose a canyon, delta, or mountain from either a topographic or satellite map, and build a model of the feature. Predict how the feature may be reshaped over time by weathering and erosion. Demonstrate how the model feature was formed, and evaluate the advantages and limitations of the model. (8.3B, 8.3C; 8.9C) ELPS 1E; 3J; 5G

Key Understandings and Guiding Questions:

- Topographic maps and satellite views show details of land features and how they change over time.
  - What is a topographic map?
  - What is a satellite view?
  - How are land and erosional features depicted on topographic maps and satellite views?
  - How are changes in elevation shown on a topographic map?
- Topographic maps and satellite views may be used to predict how land and erosional features may be reshaped by weathering.
  - How can land features be reshaped over time?
  - How can topographic maps and satellite views be used to predict how land features may change over time?

Vocabulary of Instruction:

- topography
- topographic map
- elevation
- contour line
- contour line interval
- satellite map
- relief

Materials:

Refer to Notes for Teacher section for materials.

Attachments:

- Handout: **Drawing a Mountain** (1 per group and 1 for projection)
- Teacher Resource: **Map Language Card Sort** (see Advance Preparation, 1 set per group)
- Teacher Resource: **Map Language Card Sort KEY**
- Teacher Resource: **Maps Notes Template** (1 for projection)
- Teacher Resource: PowerPoint: **Topography**
- Handout: **Elevating Layers** (1 per student and 1 for projection)
- Teacher Resource: **Satellite Map Examples** (1 for projection)
- Teacher Resource: **Satellite Maps** (see Advance Preparation, 1 set per 3 stations)
- Teacher Resource: **Satellite Maps KEY**
- Teacher Resource: PowerPoint: **Landforms**
- Teacher Resource: **Performance Indicator Instructions KEY** (1 for projection)

Resources and References:

- How to Read a Map: http://www.webrangers.us/activities/readingmap/
- Comparing Types of Maps: http://www.satsig.net/maps/lat-long-finder.htm
- Satellite Images: www.flashearth.com
- Maps for Performance Indicator: http://nationalmap.gov/ustopo/
- Optional: Comparing types of maps: http://maps.google.com/maps
- Maps and Globes: http://www.mcwdn.org/MAPS&GLOBES/MapsGlobesHome.html
- Comparing Satellite and Topographic Views. http://msrmaps.com/
- Background Information:
  - http://topomaps.usgs.gov/
  - http://squall.sfsu.edu/crws/map_info/satimg_info.html

Advance Preparation:

1. Prior to Day 1:
   - Perform a web search to locate a map of local topographical sites of interest, such as a state park, to use during the Engage portion of the lesson. You may find it helpful to include “satsig + maps” in your search or access Google Maps. The map will need to be able to be shown in “map” view, “terrain” view, and “satellite” view. You will need to provide students with the exact latitude and longitude coordinates of the location.
   - Consider preparing a dough “mountain” to model each step of the **Drawing a Mountain** activity in order to provide a visual example (see Handout: **Drawing a Mountain**).
   - Prepare an area for groups to store their models until the completion of the next lesson.
2. Prior to Day 2, copy on cardstock, laminate, cut apart, and bag the Teacher Resource: **Map Language Card Sort** (1 set per group). The terms are correctly matched to their definitions on the Teacher Resource: **Map Language Card Sort KEY**.
3. Prior to Day 4 :
   - Cut 2.5 cm (½ inch) strips from a corrugated cardboard box. Students can cut these strips into 2.5 cm squares during the activity, or the teacher can cut them ahead of time. The spacers are placed between seven of the layers, so approximately 15–20 spacers are needed per model. The actual number will vary. (Dry sponges can be substituted for cardboard.)
   - You may wish to prepare a model of the Elevating Layers activity to provide a visual example.
4. Prior to Day 5:
   - Perform a web search for satellite images for the purpose of modeling student expectations. You may find it helpful to include “flashearth + satellite images” in your search. You may wish to use Google Earth as an alternative. The Grand Canyon in AZ is a commonly searched example. Download, print in color, and laminate the following satellite images for students to analyze at their Satellite Maps stations. Label each image with its location.
     Station 1:

- Padre Island, TX
- South Padre Island, TX

Station 2:

- Seminole Canyon Val Verde, TX
- Palo Duro Canyon, TX

Station 3:

- McDonald Observatory, TX
- Franklin Mountains El Paso, TX

- Copy, laminate, and cut apart the Teacher Resource: **Satellite Maps** (1 set per 3 stations). Six to nine total stations are recommended.

5. Prior to Day 6, access http://nationalmap.gov/ustopo/ and download and print in color a satellite map and topographic map for a mountain, a canyon, and a delta. Students will need these maps and images to complete the Performance Indicator. You will need enough copies for groups of 2–3 students.
6. Prepare attachments as necessary.

Background Information:

This lesson includes student expectations that address the interpretation of topographic maps and satellite images to identify land and erosional features. Students are expected to use topographic maps and satellite images to predict how land features may change over time due to weathering.

In Lesson 01 of this unit, students are introduced to the historical development of evidence that supports plate tectonic theory. Students relate plate tectonics to crustal feature formation. During this lesson, students will be introduced to the interpretation of topographic maps and satellite views to identify land and erosional features and predict how these features may be reshaped by weathering. Students should develop an understanding that scientific investigations usually involve the collection of relevant data, the use of logical reasoning, and the devising of hypotheses and explanations to make sense of the collected data. After this unit, plate tectonics and topographic maps are not addressed again in Grade 8.

STAAR Note:
Identification of erosional features through topographical maps and satellite views, and prediction of the reshaping of those features by weathering (8.9C) will be assessed as Readiness Standards under Category 3: Earth and Space on the STAAR Grade 8 Science Assessment.

GETTING READY FOR INSTRUCTION SUPPLEMENTAL PLANNING DOCUMENT

Instructors are encouraged to supplement and substitute resources, materials, and activities to differentiate instruction to address the needs of learners. **The Exemplar Lessons are one approach to teaching and reaching the Performance Indicators and Specificity in the Instructional Focus Document for this unit.** Instructors are encouraged to create original lessons using the Content Creator in the Tools Tab located at the top of the page. All originally authored lessons can be saved in the "My CSCOPE" Tab within the "My Content" area.

INSTRUCTIONAL PROCEDURES

Instructional Procedures

ENGAGE – My Location

1. Project a teacher selected map (see Advance Preparation).

2. Provide students with the exact longitude and latitude coordinates of the particular location.

3. Ask students to round the first set of coordinates to a whole number and include the directions. They are to record this information in their science notebooks. For example, the actual data in the box below would be recorded as Lat. 28° N, Long. 98°W.

Latitude = 28.6962, Longitude = -98.6572 **Lat. = 28 degrees, 41.8 minutes North** **Long. = 98 degrees, 39.4 minutes West**

Notes for Teacher

NOTE: 1 Day = 50 minutes
Suggested Day 1

Science Notebooks:
Students record the latitude and longitude for their search, as well as the differences in the three views of maps in their notebooks.

Instructional Procedures

4. Show the three different views of the location; map, terrain (topographic), and satellite.

5. If available use a zoom feature to view local areas of topographical interest or reset the map using a new zip code. Again, show all three views of the site you have chosen.

6. Allow students to discuss differences they see in the three views.
   Responses may vary, but students should realize that each view has its own unique characteristics of detail. A satellite map shows a broad view while a topographic map shows individual details. A road map shows locations of roads, towns, etc.

7. Instruct students to record the differences in the three views of maps in their notebooks.

EXPLORE – Drawing a Mountain

1. Project the Handout: **Drawing a Mountain**.

2. Review procedures, and clarify any parts of the activity that students do not understand. If you have created a completed model, (see Advance Preparation) share the model as a visual example at this time. Discuss cleanup procedures at this time.

3. Inform students that each group will build one mountain, but each student will create their own topographic map by tracing around the slices of the model. Distribute a sheet of paper to each student.

4. Divide the class into groups of 3–4, and distribute the Handout: **Drawing a Mountain** to each group.

5. To ensure all students participate, consider assigning roles such as Building Manager, Measurement Manager, Labeling Manager, and Cutting Manager.

6. It should take students about five minutes to construct a mountain.

7. Instruct students to make a sketch of the model in their notebooks. Measuring 2.5 cm, marking the "N" on each level, and the cutting with floss should take 10–15 min.

8. Instruct students to place the slices back in their original form once they have finished tracing the slices of mountain.

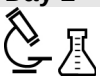
9. Monitor and assist groups as needed.

10. Instruct students to affix their maps in their notebooks (if they have not already done so) and to write comparisons between the map they created and the original model.

11. Instruct students to look at the maps they created.
    Say:
    - **You have just created a topographic map. Topographic maps show the three dimensional high and low elevations of an area of land in two dimensions.**

Notes for Teacher

Suggested Days 1 (continued) and Day 2



Materials:
- completed mountain model (see Advance Preparation, 1 per teacher)
- pencils (unsharpened, 2 per group)
- ruler (metric, 1 per student)
- dental floss (50 cm per group)
- modeling dough (2 cans per group)
- paper (copy,1 sheet per student and 1 sheet per group)
- glue or tape (per group)

Attachments:
- Handout: **Drawing a Mountain** (1 per group and 1 for projection)

Instructional Notes:
Consider creating a mountain prior to class, and model each piece as the procedures are reviewed.

Prepare an area for groups to store their models until the completion of the next lesson.

Consider allowing students to take photographs of their models and maps.

STAAR Note:
This is the first time students have been introduced to topographic maps and satellite images in science.

Instructional Procedures

- **Topographic maps show natural features such as mountains, rivers, valleys, and manmade features such as major roads and buildings.**
- **Both of them are shown to make it easier to use the map and find specific locations.**
- **In the next portion of our lesson, we will continue working with our models and maps.**

12. Instruct groups to place their models in a designated location with a name label attached.

EXPLAIN – Map Language

1. Instruct students to sit with the same groups as they did for the previous activity.

2. Direct student attention back to the map and model they created. (Groups should retrieve their models from the designated location.)

3. Distribute a card set from the Teacher Resource: **Map Language Card Sort** to each group (see Advanced Preparation). Explain to students that in order to understand topographical maps, they will need to know some common language or terms for working with those maps.

4. Instruct students to match the cards to the best of their abilities.

5. Monitor and facilitate by asking guiding questions as students complete the card sort. Do not correct students at this time.

6. Instruct students to keep the cards displayed on their tables.

7. Project the Teacher Resource: **Maps Notes Template**, and instruct students to set up pages for taking notes in their notebooks using this structure. (Consider placing one copy of Teacher Resource: **Maps Notes Template** at each group for reference).

8. Project the Teacher Resource: PowerPoint: **Topography**

9. Instruct students to do the following as you progress through the **Topography** presentation:
   - **Label their maps of the mountain model from the previous activity**
   - **Adjust their card matches on the table, as necessary**
   - **Take notes in their notebooks**

10. Facilitate by explicitly directing and redirecting students as to exactly what they need to do in a step by step fashion as you progress through the presentation. Pause often and gently remind students of the expectations. It may be helpful to create additional sketches on the board to emphasize some of the slides.

11. Ask Guiding Questions to involve students in the process.

12. Monitor and assist students as they label maps, take notes, and match cards.

13. At the completion of the presentation, facilitate a discussion using the following questions. Allow students to use cooperative learning strategies during discussions to facilitate processing of new information.
    Say/Ask:

Notes for Teacher

Science Notebooks:
Students sketch their model in their notebooks, affix their topographic maps, and write a comparison of the model and map in their notebooks.

Suggested Days 2 (continued) and 3

Attachments:
- Teacher Resource: **Map Language Card Sort** (see Advanced Preparation, 1 set per group)
- Teacher Resource: **Map Language Card Sort KEY**
- Teacher Resource: **Maps Notes Template** (for projection)
- Teacher Resource: PowerPoint: **Topography**

Instructional Notes:
Students will be multi-tasking, so it is important to be structured, explicit, deliberate, and patient during this phase of the lesson.

Maintain a close proximity to students who may need assistance.

Consider placing one copy of Teacher Resource: **Maps Notes Template** at each group for reference. This will accommodate ELLs, visually impaired or struggling learners.

Allow students to use cooperative learning strategies during discussions to facilitate processing of new information.

Check for Understanding:
Discussion questions provide an opportunity for a formative assessment of student understanding.

The **Map Language Card Sort** may be used as evidence of understanding.

Science Notebooks:
Students record Maps Notes in their science notebooks and label their maps.

Instructional Procedures

- **Compare the topographic map you have just made to the model mountain.**
- **Why are some of the traced lines closer together than others?** *Not all of the sides of the mountain were identical in shape and size.*
- **What kind of slope gives you lines that are close together?** *Steep slope*
- **What kind of slope gives you lines that are far apart***? Flatter surfaces or gently rising hills*
- **On your topographic map, where are the steepest slopes?** Answers may vary, *but students should look for the area where their lines are closest together.*
- **Look at the V – shape on your model and map. What does it represent?** *A stream or valley. The V points upstream to higher elevations.*
- **Looking at your map, where would be the best place to build a trail to climb to the top of the mountain?** Answers may vary, *but students should realize that a slope that is not steep is the best place to build a trail.*

14. Collect **Map Language Card** sets.

Notes for Teacher

EXPLORE/EXPLAIN – Elevating Layers

Suggested Day 4

1. Distribute and the Handout: **Elevating Layers** to each student.

2. Project the Handout: **Elevating Layers** and review procedures with students.

3. Clarify understanding of expectations and answer any questions students may have. If you have completed a model as a visual example, share it at this time.

4. Distribute materials for construction of models (see Advance Preparation).

5. Monitor and assist as students complete their models.

6. When students have finished building the model, allow them to work with a partner to answer the questions at the bottom of page 1 in complete sentences.

7. Monitor and assist student pairs as they answer questions.

8. Instruct students to cut off the questions section of the page and affix it and the map to their science notebooks.

9. Ask students to share answers.
   - **If the first layer is sea level and the contour interval is 10 ft., what is the elevation of each of these pre-labeled points on your model?**
     (A= *0 ft.* B= *10 ft.* C= *20 ft.* D= *30 ft.* E= *40 ft.* F= *50 ft)*
   - **Which is the steepest slope on the hill: N, S, E, W? How do you know?**
     The east slope is steepest because the lines are closer together. The indented points that look like a "V" on the west side is pointing uphill indicating a river may have cut through the layers.
   - **What is the difference in elevation between the 2nd and 4th layer of the model?** *20 ft.*

Materials:
- completed Elevating Layers model (see Advance Preparation, 1 per teacher)
- paper (construction, 8 colors, including black and white, 8 sheets per student)
- spacers (see Advanced Preparation, cardboard, corrugated, 2.5 cm squares, 15–20 per student)
- glue (liquid, 1 bottle per group)
- scissors (1 per student
- tape or glue (per group)

Attachments:
- Handout: **Elevating Layers** (1 per student and 1 for projection)

Instructional Notes:
Dry sponges can be substituted for cardboard spacers.

Consider having a completed model for students to have a visual example.

Science Notebooks:
Students affix the model and the question/answer section of the handout in their science notebooks.

Instructional Procedures

EXPLORE/EXPLAIN – Satellite Maps

1. Project the Teacher Resource: **Satellite Map Examples**.

2. Ask:
   - **What features are represented on each of the images?** *Answers will vary; landforms.*
   - **How are satellite images different from topographic maps?** *Satellite maps do not show elevation.*
   - **What causes features of earth to change over time?** *Weathering, erosion, and deposition.*

3. Model student expectations by projecting the teacher selected satellite images (see Advance Preparation).

4. Divide the class into groups of 3–4 to complete satellite maps stations (see Advanced Preparation and Teacher Resource: **Satellite Maps**, 1 set per 3 stations).

5. Instruct students to rotate through stations 1, 2, and 3 at teacher direction, and complete the tasks.

6. Instruct students to answer the questions at each station in their science notebooks.

7. Once students have completed the three stations, project Teacher Resource: **Satellite Maps KEY**.

8. Facilitate a discussion regarding the differences in topographic and satellite maps, including their advantages and limitations.

9. Instruct students to record the differences in topographic and satellite maps, including their advantages and limitations, in their notebooks.

ELABORATE – Change Over Time

1. Project the PowerPoint: **Landforms** and interactively progress through it with the students.

2. Facilitate a discussion during the PowerPoint using the following questions. Allow students to use cooperative learning strategies during discussions to facilitate processing of new information.
   Ask:
   - **How would a mountain change over time due to weathering?** *Accept all reasonable answers.*
   - **How would changes due to the weathering of a mountain be reflected in a map?** *Elevation would decrease; steep mountains would eventually become less steep and more rounded.*
   - **How would a canyon change over time due to weathering?** *Accept all reasonable answers.*
   - **How would changes due to the weathering of a canyon be reflected in a map?** *Canyons would become deeper; slope of the canyon sides will become steeper.*
   - **How would a delta change over time due to weathering?** *Accept all reasonable answers.*
   - **How would changes due to the weathering of a delta be reflected in a map?** *Delta will either become broader due to increased deposits*

Notes for Teacher

Suggested Day 5

Materials:
- Satellite images (see Advance Preparation)

Attachments:
- Teacher Resource: **Satellite Map Examples** (1 for projection)
- Teacher Resource: **Satellite Maps** (see Advanced Preparation, 1 set per 3 stations)
- Teacher Resource: **Satellite Maps KEY**

Instructional Notes:
Setting up 6-9 total groups to accommodate smaller groups sizes is recommended. If you do not have access to student computers for this activity, images of maps may be printed in color and laminated to use for the station activities.

Science Notebooks:
Students record the answers to the station questions in their notebooks, as well as the differences in topographic and satellite maps, including their advantages and limitations.

Suggested Day 6

Attachments:
- Teacher Resource: PowerPoint: **Landforms**

Instructional Notes:
Students will struggle with illustrating the canyon in the Check for Understanding. Facilitate the process through questioning.

Check for Understanding:
Illustrate a topographic map of a mountain, canyon, island, and delta before weathering, erosion and deposition and their prediction of what it will look like after weathering, erosion and deposition.

Instructional Procedures

or diminish due to lack of deposits and wave action carrying existing deltas away.

- **How would an island change over time due to weathering?** *Accept all reasonable answers.*
- **How would changes due to weathering of an island be represented on a map?** *The island will change shapes and move over time due to erosion and deposition.*
- **Would these changes occur at fast or slow rate?** *Very slowly; possible exception of delta changes which could be observed in as little as 10 years.*

3. Instruct students to answer the PowerPoint questions in their notebooks during the discussion.

4. **Check for Understanding:**
Instruct students to draw a table in their notebooks to illustrate a topographic map of each landform before weathering, erosion and deposition and their prediction of what it will look like after weathering, erosion and deposition.
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Landform	Before	After
Mountain		
Canyon		
Island		
Delta		

Notes for Teacher

Science Notebooks:
Students record the answers to the questions from the PowerPoint, and diagram the "Before and After" landforms in their notebooks.

EVALUATE – Performance Indicator

Performance Indicator

- Choose a canyon, delta, or mountain from either a topographic or satellite map, and build a model of the feature. Predict how the feature may be reshaped over time by weathering and erosion. Demonstrate how the model feature was formed, and evaluate the advantages and limitations of the model. (8.3B, 8.3C; 8.9C) ELPS 1E; 3J; 5G

1. Refer to the Teacher Resource: **Performance Indicator Instructions KEY Rubric** for information on administering the performance assessment.

Suggested Days 6 (continued) and Day 7

Materials:

- topographic maps (see Advance Preparation, various per class)
- satellite images (see Advance Preparation, various per class)
- modeling compound (2 cans per group)
- paper (construction, various colors, 9"x12", 1 per group)
- scissors (2 per group)
- glue (1 bottle per group)
- colored pencils (1 set per group)
- modeling delta and canyon formation
  - pan (aluminum, rectangular, 1 per group)
  - sand (1 quart bag per group)
  - water (1000 mL)
  - beaker (1000 mL, 1 per group)
  - graduated cylinder (100 mL, 1 per group)

Attachments:

Instructional Procedures

Notes for Teacher

- Teacher Resource: **Performance Indicator Instructions KEY Rubric** (1 for projection)

Misconception:

- Students may think that landforms of similar appearance are formed in only one manner.