

Science Activity 4: Shape Up: Introducing Topography

Educator Preview

Activity Snapshot

Learners build three-dimensional models of topographic maps and then turn them into two-dimensional maps.



Timing | 45 minutes

Get Ready and Team Up	10 min.
Build Topographic Models	25 min.
Reflect	10 min.
Total	45 min.



Prep Snapshot*

Prep Time 30 min.

Print resources.

**See Materials & Preparation for full info.*



21st Century Skills

Connection

- Critical Thinking

Science Practices

- Analyzing & Interpreting Data
- Planning Investigations



Guiding Question

How can maps help us understand a planet's landscape?

Learners Will Do

Interpret topographic maps to identify flat areas and landforms.

Learners Will Know

A topographic map represents the three-dimensional shape of land in an area in two dimensions.



Connecting Across Activities

Activity 3: Landforms on Mars	Activity 4: Introducing Topography	Activity 5: Exploring Topography on Mars
Last time , learners acted as scientists to examine images of landforms on Mars. These images are the first set of data they will use to choose a landing site.	Today , they deepen their understanding of landforms by considering topography.	Next time , they will interpret Mars topographic maps. These maps are the second set of data they will use to choose a landing site.

Activity Resources

Access videos and digital resources using the link or QR code below. More information for teaching this curriculum is available in the [Educator Guide Introduction, pgs. iii-xxvi](#). Access more PLANETS units, research, and pathways at <https://planets-stem.org/>.

QR Code for Activity Resources



weblink: <https://hov.to/43551cda>

Materials and Preparation

Materials

For the whole group

- *Our Ideas* poster (on paper or a shared digital document) in Prep & Setup Guide (PDF) [Examples](#) | [Templates](#)

For each group of four

- [Science Activity 4 Topography Template Handout, pg. 60](#)
- 1 sheet of foam, craft (or cardboard)
- scissors
- tape, masking
- glue sticks (optional)
- writing utensils (pencils or crayons), colored, in gradually darker, but non-adjacent shades of yellow, green, and blue if possible
- Resealable bag or paper clip (optional)
- [Science Activity 4 Grand Canyon Topographic Map Handout pg. 61](#) or local topographic map
- [Science Activity 4 Grand Canyon Aerial Photo Handout pg. 62](#) or local aerial photo
- Optional: Print the image in *Science Activity 4 Grand Canyon Topographic Map* on [swell paper \(weblink\)](#).



Support Learner Differences

Consider providing the cut foam pieces instead of having learners cut them using the [Science Activity 4 Topography Template Handout, pg. 60](#).



Some learners may have color blindness to certain color combinations. Allow them to choose colors that work best for them and suggest adding different patterns on each layer to add extra contrast.

Activity 4 Materials Preparation (10 min.)

Ahead of Time

1. Review the *Our Ideas* poster in the [Prep & Setup Guide - Examples \(PDF\)](#) to help you think about what to add to the *Our Ideas* poster during the discussions in this activity.
2. Make copies of the *Science Activity 4 Topography Template Handout*, pg. 60 for each group of four.
3. Make a sample topography model using the directions on the *Science Activity 4 Topography Template Handout*.
4. Obtain or download topographic maps and aerial images of your local area if you are using this option. You will need Adobe Reader or comparable PDF viewing software to use the option below.
 - a. To find a topographic map of your local area, use the [USGS TopoView website](#). Search for your location in the search field in the upper right.
 - b. Once you have found your location, narrow down the list of available maps by adjusting the Date slider in the upper right to only show recent years.
 - c. Select a map from the list and click the “Show” icon to show it on the main map. If this looks like it covers the correct area, download a GeoPDF file of the map.
 - d. Open the GeoPDF Adobe Acrobat Reader* (not online). There is a lot of information in the PDF, but if it’s too cluttered, you can turn some of it off. When you open the PDF in Adobe Acrobat, you should see a list of “layers” on the left. If you don’t see this, go to View > Show/Hide > Side Panels/ Navigation Panes > Layers
 - e. For the simplest possible topographic map, you can turn off all layers except for “Contour Features.” However, you may find it useful to keep some other layers turned on, such as “Transportation” (to see roads) or “Geographic Names” (to see landmarks).
 - f. You may also choose to zoom in on the map to see details more clearly.
 - g. To see a satellite view/aerial photo of the map area, turn on the Images layer in the PDF and turn off contours.

*To *save* the image or the map displaying only the layers you choose, you will need Adobe Acrobat. Export to an image.



Support Thinking

We suggest you start this activity by going outside and exploring the local terrain. Choose an area with some noticeable elevation changes, if possible.

A topographic map of the Grand Canyon is provided in case you live in a very flat area; however, we highly recommend you download a topographic map and aerial images of an area that is familiar to learners from [TopoView](#). These resources are especially important if you are unable to go outside.

5. Print one *Science Activity 4 Grand Canyon Topographic Map Handout*, pg. 61 and *Science Activity 4 Grand Canyon Aerial Photo Handout*, pg. 62—or local area maps—per group of four learners.

In Your Space

6. Place the *Our Ideas* poster in a visible place in your learning setting or prepare to share it digitally.



Activity Guide

Get Ready and Team Up (10 min.)

1. Ask: **If you did the last activity, what did you do and why?** (*We examined images of Mars to identify water-based landforms. We chose which landing site would be most interesting to send a rover to.*) Invite learners who were present to share findings from the *Our Ideas* poster and their notebooks.
2. Say: **Our challenge is to choose the best landing site to search for past liquid water.**
3. Say: **Today we will focus on choosing a safe landing site.** On the *Our Ideas* poster, focus on the questions about how safe and easy it is to land a rover on Mars. If there are no questions in this category, ask: **What else might we need to know about the landforms or the rover?** (*The size and height of the landforms, the materials they are made from, space the rover needs, etc.*) Invite learners to add additional questions.
4. Share the Guiding Question with learners, aloud and in writing, or share a similar question from the *Our Ideas* poster. Guiding Question: **How can maps help us understand a planet's landscape?** Say: **You will get to explore real maps of Mars later, but first you will make models to understand how maps can show the height of the land. Then it will be easier for you to understand the Mars maps.**
5. Organize learners into groups of four.



Support Learner Differences

- ✦ If new learners are joining you, lead an [inclusion activity](#) (pgs. xx-xxi) and use other [engagement strategies as necessary](#) (pgs. iii-xxvi). 
- ✦ If you have learners who speak multiple languages, encourage them to form answers with each other in their preferred languages first, then share answers in the language of the whole group. 



Teaching Tip

Learners may not have asked about topography directly, but they may have asked related questions. For example, to answer the question “Where can a rover land?”, they will need to know the topography of the landing sites.

Build Topographic Models (25 min.)

6. Hold up your sample topography model as you say: **Today we will create a model of a hill using foam pieces to represent the different heights of the hill.** As needed, allow learners to feel the sample model.
7. Hold up the *Science Activity 4 Topography Template Handout*, pg. 60 and demonstrate as you say: **You will get a paper template to create your model. The largest shape on the template represents the lowest spot on the hill. It will be the bottom layer. Each of the other shapes are slightly smaller and represent a slightly higher part of the hill. First, you will decide how to color each shape so you have darkest (shape 1, blue) to lightest (shape 7, yellow). Then, you will cut out the shapes.**
8. Provide each group with one copy of the *Science Activity 4 Topography Template Handout*, pg. 60, scissors, and colored writing utensils. Allow them 5 minutes to color and cut out the shapes.
9. When groups are ready, demonstrate as you say: **Next, trace the paper shapes onto one sheet of craft foam (or cardboard) and cut out the pieces. You only get one piece, so you have to plan carefully. Save these paper pieces—we will use them later. Then tape your craft-foam (or cardboard) shapes together using tape loops on the back of each shape. Begin with the largest shape and attach the next smallest shape to it, and then the next smallest, so that each shape is fully within the boundary of the one below it.**



Support Thinking

If time and weather permit, go outside and travel with learners across areas of varying height and slope. Ask: **What do you notice about the height of the land as we travel?** (*It is going up or down; it is steep, not steep, or flat; it is difficult or easy to travel on; or it is a landform such as a valley or hill, etc.*) **Where would be the best place to have a picnic or play a game of soccer? Why? When would it be good to know ahead of time if the land is steep or not? Why?** (*Before traveling across the land so we know how difficult it will be and if we need special equipment to help us, etc.*)

If your environment allows, have learners spread out to areas of different heights. Have learners observe each other spatially and ask: **How could we record these changes in height on a map?** (*Using color, texture, measurement numbers, lines to represent different heights, etc.*)



Support Learner Differences

Encourage learners to use patterns or textures instead of colors to indicate the different layers if they find that more useful or accessible.



Teaching Tip

Groups can cut the paper template in half or thirds, leaving one to four shapes on each section so multiple learners can color at once and then cut out the detailed shapes. This can be repeated with the cutting of foam.

10. Provide one piece of craft foam or cardboard, a roll tape and/or a glue stick per group and provide 5 minutes to create the models.

11. Say: **Now you have a three-dimensional model of the shape of a hill. If we combine our models, we can make a three-dimensional model of the land.** If time, invite learners to combine their models, leaving room in between to represent flat areas. As needed, give learners time to feel the combined model. Say: **The shape of the land in an area is called that area's topography.** Write the word *topography* on the *Our Ideas* poster.



Teaching Tip

Provide each group with a bag or a paper clip to keep their cut paper template pieces together.

Using loops of tape between layers and not pressing layers down helps to increase the height of the topographic models.

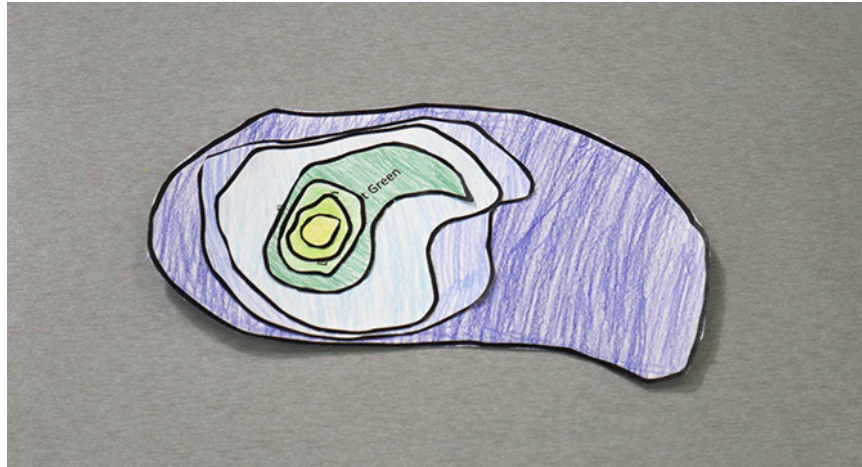


Support Learner Differences

As needed, provide groups with a tub or other container to hold their materials, which is especially helpful for blind learners.



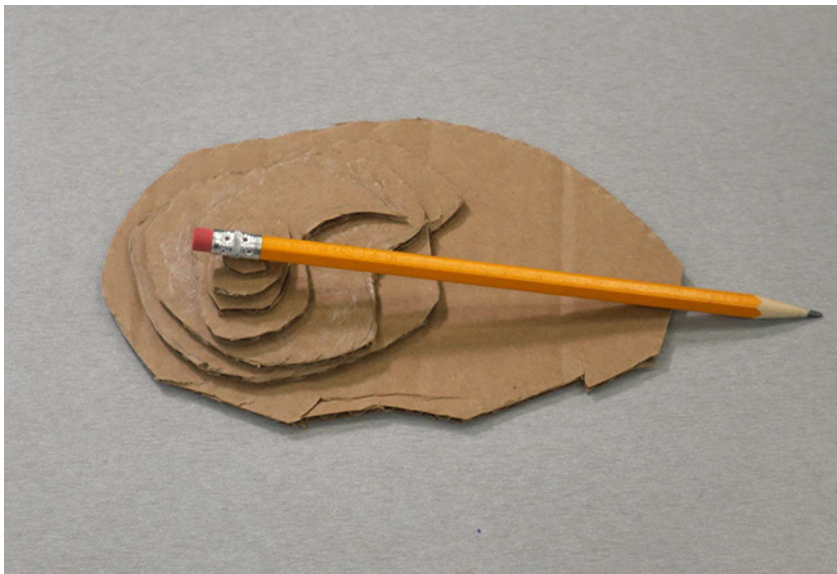
12. Say: **Because it's not easy to carry around three-dimensional models of places, we rely on flat, two-dimensional maps.** Demonstrate as you say: **Make a map from the paper pieces you saved. Tape or glue the layers of the paper templates in the same way as the foam pieces, then trace the outline of each layer so you can see the lines.** Provide 5 minutes for learners to construct their maps.



Topography template pieces combine to make a two-dimensional topographic map

13. While learners are working, help them understand their maps. Ask: **Because these layers are all flat, how can you tell which layer stands for the highest area and which stands for the lowest?** *(The lightest color layer is the highest area, and the darkest color is the lowest.)* **What does each line represent?** *(Each line represents land at the same height.)* **What does it mean when the lines are close together? When they are far apart?** *(Where there are a lot of lines close together, the slope is very steep. When the lines are far apart, it is not as steep.)* **Are there areas around here that have topography similar to what is represented by this map?** *(Local steep areas, such as hillsides and cliffs, could be represented by areas of the map where the lines are close together. Local flat areas, such as fields and plains, could be represented by areas on the map where the lines are far apart.)*

14. After learners have made their maps, say: **The lines on your map trace places that are all the same height. If you walked one of these lines on the ground, you would never go up- or downhill. The different lines on your maps show different heights. Because the maps show topography, these maps are called *topographic maps*. You just created topographic maps.** Write the term *topographic map* on the *Our Ideas* poster.
15. Provide each group with a pencil. Use hand gestures to indicate changes as you say: **Place the pencil on different parts of your foam/cardboard model. Using the information from the map, decide whether your pencil would be flat or tilted if it was really in this location.** *(It would be tilted if it is sitting across lines and level/flat if it is not sitting across any lines.)* Give them a few minutes to test their models. As they work, ask: **If you want your pencil to be stable and not tilt, where should you place it? Why?** *(You should place the oval/ pencil on a single layer because it doesn't tilt there. If it is on multiple layers, it tilts.)*



The best landing site will tilt the pencil the least.



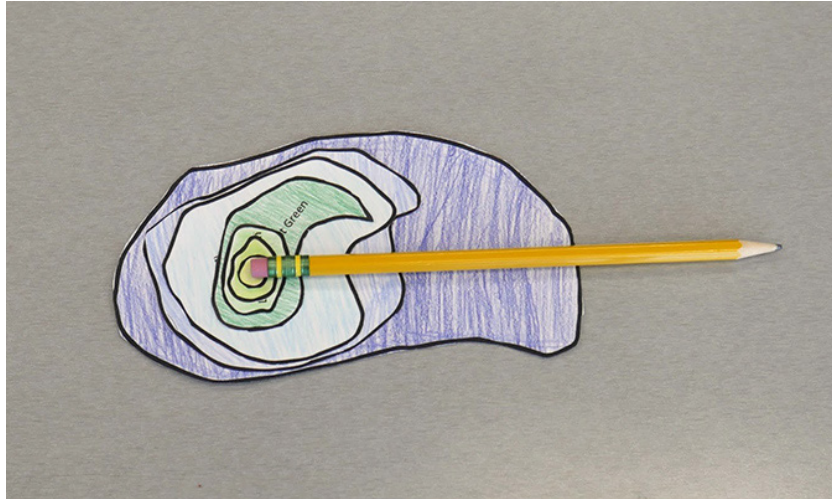
Support Thinking

✦ To support understanding of the word *topographic*, tell learners that it comes from the roots *topo*, meaning “place,” and *graph*, meaning “to write or draw.” Have learners think of other words they know that come from similar roots, such as *utopia* (a good or nonexistent place), *dystopia* (a bad place), *graph* (a drawing of data), *graphite* (a soft mineral that leaves a gray streak, used to make pencil “lead”), and *bolígrafo* (Spanish for pen).

Allow learners to share stories about any previous experiences with topographic maps, such as when hiking or using depth finders for fishing. You can also prompt learners to consider the topography of indoor spaces, such as the height and arrangement of different items in a room.

✦ The pencil is a way to measure the average slope across the area that it spans. Encourage learners to notice where the lines on the 3D model appear closer together. Ensure learners understand that lines that are closer together indicate steeper slopes.

16. Say: **Now place the pencil on different parts of your paper model.** Using the information from the map, decide whether your pencil will be flat or tilted in different locations. Give them a few minutes to test their models. As they work, ask: **If you want your pencil to be stable and not tilt, where should you place it? Why?** (You should place the pencil on a single layer because it doesn't tilt there. If it is on multiple layers, it tilts.)



The best landing site will tilt the oval or pencil the least.

17. Provide each group with a *Science Activity 4 Grand Canyon Topographic Map Handout*, pg. 61, and *Science Activity 4 Grand Canyon Aerial Photo Handout*, pg. 62, or the local topographic map and aerial photo. Provide 5 minutes for them to compare their topographic models to the topographic map and aerial photo. Ask questions such as: **Where is the steepest area?** (Where the lines are closest together). **Where would you want to play soccer and why?** (The flattest area.)

Reflect (10 min.)

1. Revisit the Guiding Question on the *Our Ideas* poster. Ask: **How can maps help us understand a planet's landscape?** (They show the shape of land in an area. We can see how steep an area is by looking at the lines. If the lines are close together, the landscape is steep.) Remind learners of the terms *topography* and *topographic map*.
2. Ask: **How might topographic maps help us choose a landing site?** (They show the shape of landforms. Scientists can think about how much water might have been involved in the formation of the landforms. They also help choose a safe place to land.)
3. Ask: **When might someone use a topographic map?** (Prior to construction, farming, hiking, etc.)
4. Ask: **What questions do you still/now have?** (What other types of data—besides visual and topographic data—are available? What are the landforms made of?, etc.)
5. Say: **Good job working as scientists today! Now you are prepared for next time, when you will explore topographic maps of each of the potential landing sites. Remember, the process you are following is like the process NASA uses to choose landing sites.**

After the Activity

1. Clean up:
 - Keep the *Our Ideas* poster for Activity 5.
 - Collect the topographic maps. Save them for reference in future activities or display at the Share-Out.
2. Plan ahead for Science Activity 5. See [Activity 5 Materials Preparation on pg. 64](#).
3. Take time to reflect on the following educator prompt: **How did you help learners understand the concept of a topographic map? How could you use similar strategies during future activities?**

Remote Sensing Additional Resources

QR code leads to resources available for this unit.



weblink: <https://hov.to/248cf0d9>

Topography Template

Cut out each layer and use it as a template to cut seven pieces of craft foam. Tape layers together to create a three-dimensional topographic model.

Level 1 Bottom – Darkest Blue

Level 2 – Lighter Blue

Level 5 –
Lighter Green

Level 6 –
Yellow-Green

Level 7 Top – Yellow

Level 4 – Darkest Green

Level 3 – Lightest Blue

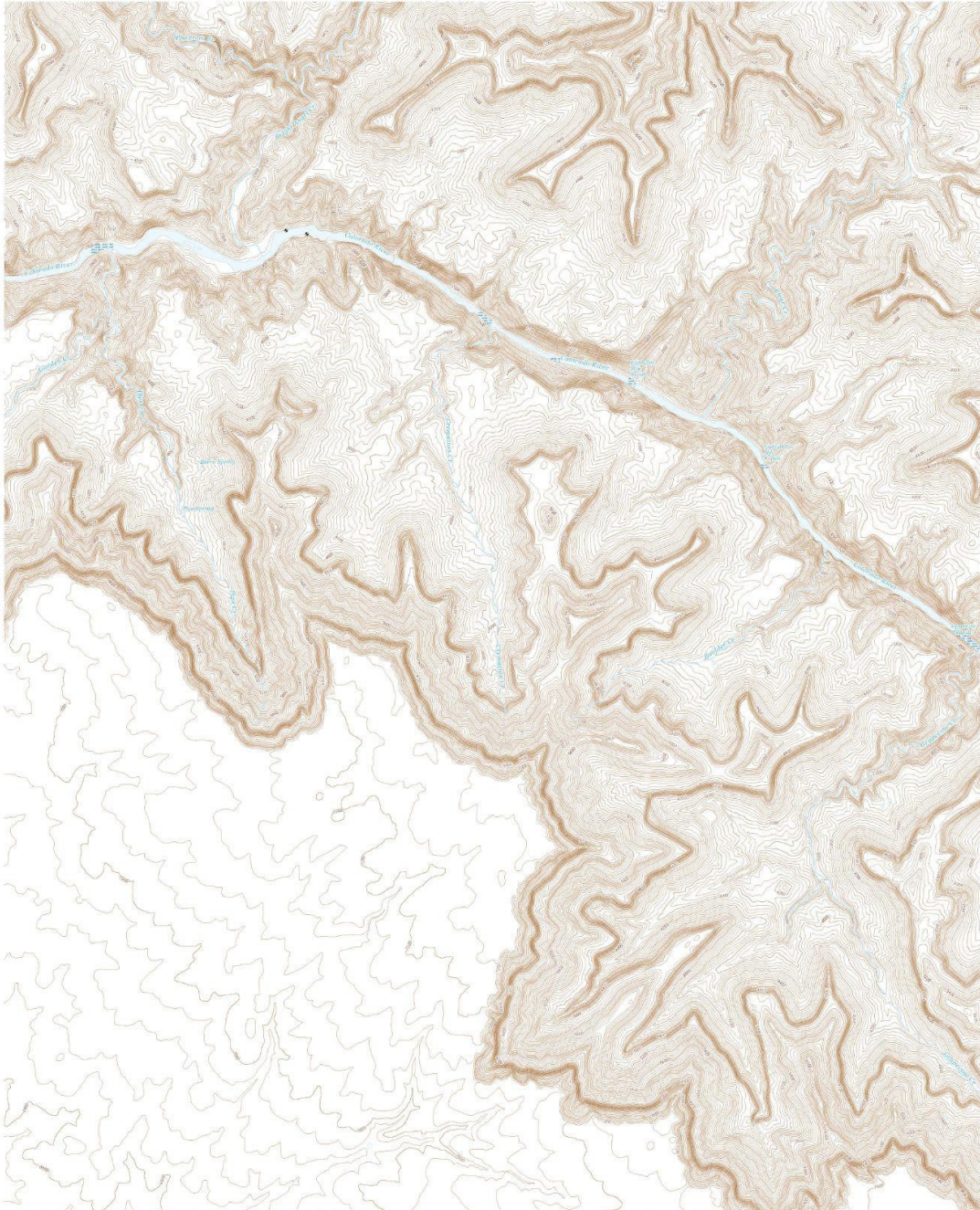
Grand Canyon Topographic Map



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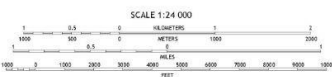
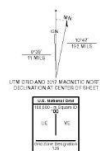
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ARIZONA - COCONINO COUNTY
7.5-MINUTE SERIES



Produced by the United States Geological Survey

North arrow (datum of 1983) (NAD83)
Horizontal datum of 1983 (NAD83). Projection and
1:50,000 scale. Contour interval 100 feet. Date 1/15/15.
This map is not a legal document. Boundaries may be
generalized for this map scale. Private lands and other
restrictions may not be shown. Obtain permission before
entering private lands.

Map data: U.S. Census Bureau, 2010
Topography: National Hydrographic Survey, 1984
Contour: National Hydrographic Survey, 1984
Boundaries: Multiple sources; see metadata file 2016
Roads: Land Survey, 2016
Metadata: PMS National Hydrographic Survey, 1984



CONTOUR INTERVAL 10 FEET
NORTH ARROW (DATUM OF 1983)
This map was produced in conformance with the
National Geospatial Program US Topo Product Standard, 2011.
A metadata file associated with this product is available online.



ROAD CLASSIFICATION

Expressway	Local Connector
Secondary Hwy	Local Road
Range	4000
Interstate Route	US Route
	State Route

PHANTOM RANCH, AZ
2018



Worlds Apart: Remote Sensing of Mars
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