Environmental Science Institute
THE UNIVERSITY OF TEXAS AT AUSTIN

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Mapping the Unknown

Lesson Plan for Grades: 6th – 8th
Length of Lesson: 2 hours

Authored by: UT Environmental Science Institute
Date created: 08/01/2016

Subject area/course: Science, Astronomy, Space

Materials:

- Topographic map exploration (per team)
  - Clear, 16-20 oz. plastic containers
  - Modeling clay or playdough
  - Sharpies
  - ½ transparency page
  - 1 (30 ml) graduated cylinder
  - Water
- Boxes with mystery landscapes (one per team)
  - Shoeboxes with lids
  - Clay or playdough
  - Grid sheet
  - Awl or Sharpened Skewer
  - Chopsticks or unsharpened skewers
  - Ruler
  - Sharpies
- Computers with internet access
- Pens, markers & posters for gallery walk

TEKS/SEs:

§112.18., §112.19. Science

(2) Scientific investigation and reasoning. The student uses scientific inquiry methods during laboratory and field investigations. The student is expected to:
(D) construct tables and graphs, using repeated trials and means, to organize data and identify patterns; and
(E) analyze data to formulate reasonable explanations, communicate valid conclusions supported by the data, and predict trends.

§112.20. Science

(9) Earth and space. The student knows that natural events can impact Earth systems. The student is expected to:
(C) interpret topographic maps and satellite views to identify land and erosional features and predict how these features may be reshaped by weathering

Lesson objective(s):

- Students will be able to read a topographic map.
- Students will be able to create their own topographic map.

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Differentiation strategies to meet diverse learner needs:

- ELL students and students with learning disabilities should have multiple forms of instruction including visual and written instruction sheets as well as verbal instruction and demonstration.

ENGAGEMENT (15 minutes)

- Working in small teams discuss the different types of maps available (topographic, climate, physical, political, road map) and answer the following questions:
  - What are some of the features of these maps? What do they show?
  - How does technology affect how we use maps?
  - In space exploration, which of these types of maps are relevant?
- Teams briefly share their results with the rest of the class. Teacher introduces the project for this lesson: teams will map an unknown landscape in a faraway planet by using a topographic map.

EXPLORATION (45 minutes)

- Working in teams, students will discover how topographic maps work and what are some of the features of a topographic map.
- Teams have 10 minutes to create a simple landscape inside the plastic container. It doesn't have to cover the bottom of the container or reach all the way to the top.
- Teacher demonstrates how to create the first layer of the topographic map using the transparency and sharpie. Teams will create the rest of the topographic map, by creating the contour at different "elevations". Teams will fill the cylinder with 30 ml of water and pour in the container evenly. The water line represents the new elevation which teams will use to create next interval line. Teams will continue adding water at 30 ml intervals until their landscape is submerged.
- In addition to their contour map, teams will do a 3-minute presentation answering one of the questions explaining how topographic maps work.
  - What is a topographic map?
  - What is elevation and how is it expressed on a topographic map?
  - What is a contour line?
  - What is a contour interval?
  - What kinds of information do topographic maps give us?
  - Why are topographic maps useful in space exploration?
    - Teacher walks around the room asking questions about what the students are doing.
    - Teacher listens to student ideas as they talk to each other.
    - Teacher provides support to students as needed (without providing the answer).

EXPLANATION (30 minutes)

- Each team does a 3-minute presentation about one of the questions related to topographic maps. Teams should use their map example to explain how each concept works. Teams may need to present in order.
  - What is a topographic map?
  - What is elevation and how is it expressed on a topographic map?
  - What is a contour line?
  - What is a contour interval?
  - What kinds of information do topographic maps give us?
  - Why are topographic maps useful in space exploration?

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- Teachers encourage students to explain concepts in their own words.
- Teachers provide important ideas that students provide.
- Teachers introduce vocabulary, formal labels or definitions as needed.

ELABORATION (30 minutes)

- Each team receives a "mystery" box representing an alien landscape in a distant planet. Teams need to find a "safe" location for an aircraft to land so teams must create a topographical map of the landscape using a "radar".
- Teams have 30 minutes to map out their alien landscape and create the topographic map. Teams must submit a final poster with their map clearly labeled and a recommended "safe" landing zone. Posters will be evaluated by three other teams using a gallery walk using the rubric provided.
    - Teachers ask student to use the new vocabulary appropriately.
    - Teachers encourage students to incorporate real world connections.

EVALUATION (throughout)

- Students will be evaluated on their posters and topographic maps using the rubrics provided.
    - Teachers ask questions that provide insight into student progress.
    - Teachers observe students as they create posters and look for evidence of understanding.

SOURCES AND RESOURCES

- Dr. Jack Holt's *Hot Science – Cool Talks* #61, "Icy Mysteries of Mars Revealed" www.hotsciencecooltalks.org
- Central Washington University, "Introduction to Topographic Maps" lesson plan, www.cwu.edu/waters/earth-science
- American Museum of Natural History, "Mapping Unknown Surfaces"
- Debra Ronca "How to Read a Topographic Map" 24 February 2009. HowStuffWorks.com. http://adventure.howstuffworks.com/outdoor-activities/hiking/how-to-read-a-topographic-map.htm

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TEACHER HANDOUT (EXPLORATION): TOPOGRAPHIC MAPS (45 minutes)

Purpose: Discover how topographic maps work and what are some of the features of a topographic map.

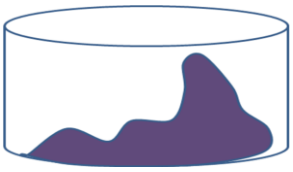
Materials (per team):

- Clear, 16-20 oz. plastic container
- Modeling clay or playdough
- Sharpies
- ½ transparency page
- 1 (30 ml) graduated cylinder
- Water

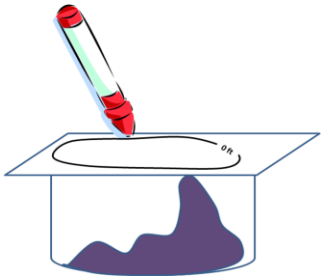
Safety Information: N/A

Procedure:

1. Each team has 10 minutes to create their own simple landscape inside the clear container. The landscape should have hills, valleys and flat areas. The highest point of the landscape should not exceed the top of the container.



2. Teams must now create a topographic map of their landscape. The transparency is put over the top of the container and the base of the landscape is traced using the sharpie.



3. To create the next contour line, fill the graduated cylinder with 30 ml of water and evenly pour it over the landscape. Teams can now draw the second contour line to match the water line.

4. Teams continue drawing a contour line for every 30 ml of water added. The final contour is the highest peak in their landscape.

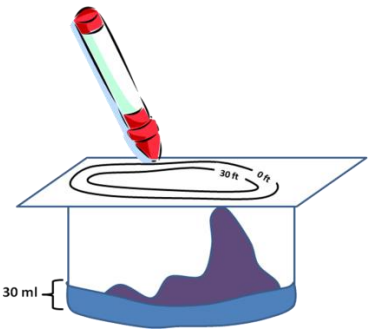


Image Source: Introduction to Topographic Maps, Central Washington University

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STUDENT HANDOUT (EXPLORATION): TOPOGRAPHIC MAPS (45 minutes)

You have 10 minutes to create a landscape inside the clear container provided. Your landscape should have some hills and valleys. It should not be higher than the size of your container. Keep it simple!

Next, use the transparency and sharpie to create the contour lines the base of the map. To create the next contour line, add 30 ml of water and draw the water line you see. Keep on adding 30 ml of water and drawing contour lines until the highest part of your landscape is completely covered in water.

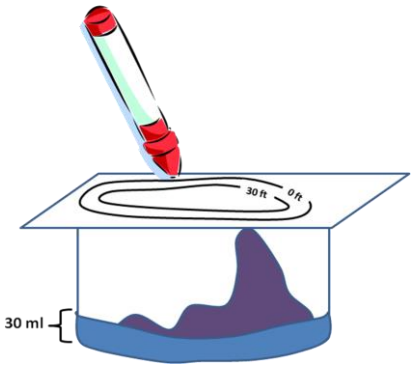

Image Source: Introduction to Topographic Maps, Central Washington University

Label each contour line of your map

Initial contour = 0 feet
30 ml of water = 30 feet contour interval

After creating the topographic map of your landscape, you will be assigned ONE of the following questions. Create a 3-minute presentation explaining the topic.

1. What is a topographic map?
2. What is elevation and how is it expressed on a topographic map?
3. What is a contour line?
4. What is a contour interval?
5. What kinds of information do topographic maps give us?
6. Why are topographic maps useful in space exploration?

Use the following reference to learn more about topographic maps:

- "How to Read a Topographic Map", http://adventure.howstuffworks.com/outdoor-activities/hiking/how-to-read-a-topographic-map.htm

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TEACHER HANDOUT (ELABORATION): Mapping the Unknown (45 minutes)

Purpose: Map an alien landscape in a distant planet. Each team needs to find a "safe" location for an aircraft to land so teams must create a topographical map of the landscape using a "radar".

Materials (per team):

- Shoeboxes with lids
- Clay or playdough
- Grid sheet
- Awl or Sharpened Skewer
- Chopsticks or unsharpened skewers
- Ruler
- Sharpies
- Markes/poster

Safety Information: N/A

Procedure:

Create landscape boxes and data collection instruments (before class)

1. Use playdough to create an uneven landscape with mountains, valleys and craters. Leave a 4 x 4 cm area flat within the box with very small change in elevation (less than 1 centimeter change). This will be the area for a landing location. You may have more than one "landing area" available.
2. Tape a copy of the grid sheet to the shoebox lid. Use an awl or wooden skewer and carefully punch holes approximately 2 cm apart. Label the grid with letters across the top and numbers down the sides.
3. Use chopsticks or unsharpened skewers to create the measuring instruments. Measure and label 1 cm increment markings in chopsticks/skewers so students can use them to measure.
4. Seal the boxes so the teams cannot see the mystery landscape.

During activity:

1. Each team receives one mystery landscape boxes. Teams will use the "measurement tools" (skewers or chopsticks) to take measurements for each hole.
2. Teams use the grid to match the dot to the hole they are measuring. Teams should place the measurement for each hole in the same location (above the dot, below, to the left or to the right).
3. All team members should have the opportunity to take measurements.
4. Teams look at the grid to see if there is a square area that is 2 holes by 2 holes where all the measurements are the same or different by no more than one centimeter. This may be a potential safe landing spot for an aircraft.
5. Teams should connect dots that have same measurements to create their topographic map. Revisit the rules for creating contour lines:
    a. Every point on a single contour line represents the same elevation.
    b. Every contour line must eventually connect at its ends- one contour cannot run into or connect to another contour line.
    c. Contour lines can never cross one another; each line represents a separate elevation.
6. Teams can now remove the lid to compare their contour map and safe landing zone to actual landscape.
7. Teams can use their grid to create a poster with their topographic map. Maps should include:
    a. Clearly defined contour lines with elevations listed
    b. Safe landing areas clearly labeled
8. Posters will be displayed in a gallery walk and evaluated by three other teams using the rubric provided.

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STUDENT HANDOUT (ELABORATION): Mapping the Unknown (45 minutes)

How do you map the surface of planet when you can't see it? Some planets are covered by thick cloud layers making it very hard to create topographic maps using photos and satellites. Scientists can use radar technology to map foreign landscapes. Spacecraft above the planet's surface send a radar beam and measure how long the signal takes to come back. The shorter the time, the higher the surface (like a peak or mountain). This way scientists can create a topographical map of unknown places.

Your team must find a "safe" landing zone that is 4 x 4 centimeters for your spacecraft to land. You must create a topographical map of a mystery box where you cannot see the landscape.

You will need:

- Mystery box landscape
- Measurement tools (wooden skewers/chopsticks)
- Grid worksheet
- Pencil
- Poster/Markers

Procedure:

1. **Get the data for the grid:**
    a. Insert the skewer in a hole until it will not go down further.
    b. Read the measurement marked in the measuring instrument (approximate if needed).
    c. Place the measurement in the worksheet grid. Be consistent where you place the measurement (above, below, left or right of the dot).
    d. All team members should have the opportunity to take measurements.

2. **Find "safe" landing zones for the spacecraft:**
    a. Look at your grid and see if there are any square areas (2 x 2 holes) where all the measurements are the same or have only one centimeter difference.
    b. Mark are areas that meet the conditions above.

3. **Create a topographical map:**
    a. Connect any dots that have the same measurements to create contour lines. Remember:
        i. Every point on a single contour line represents the same elevation.
        ii. Every contour line must eventually connect at its ends- one contour cannot run into or connect to another contour line.
        iii. Contour lines can never cross one another; each line represents a separate elevation.
    b. Add elevations to the contour lines. Open the mystery box and compare your map to the actual landscape.
4. **Create your poster:**
    a. You may want to make your map bigger or just attach it to the poster.
    b. Clearly label elevations, safe landing zones and contour lines. Put your poster in the gallery walk.
    c. Evaluate three other team posters using the rubric provided.

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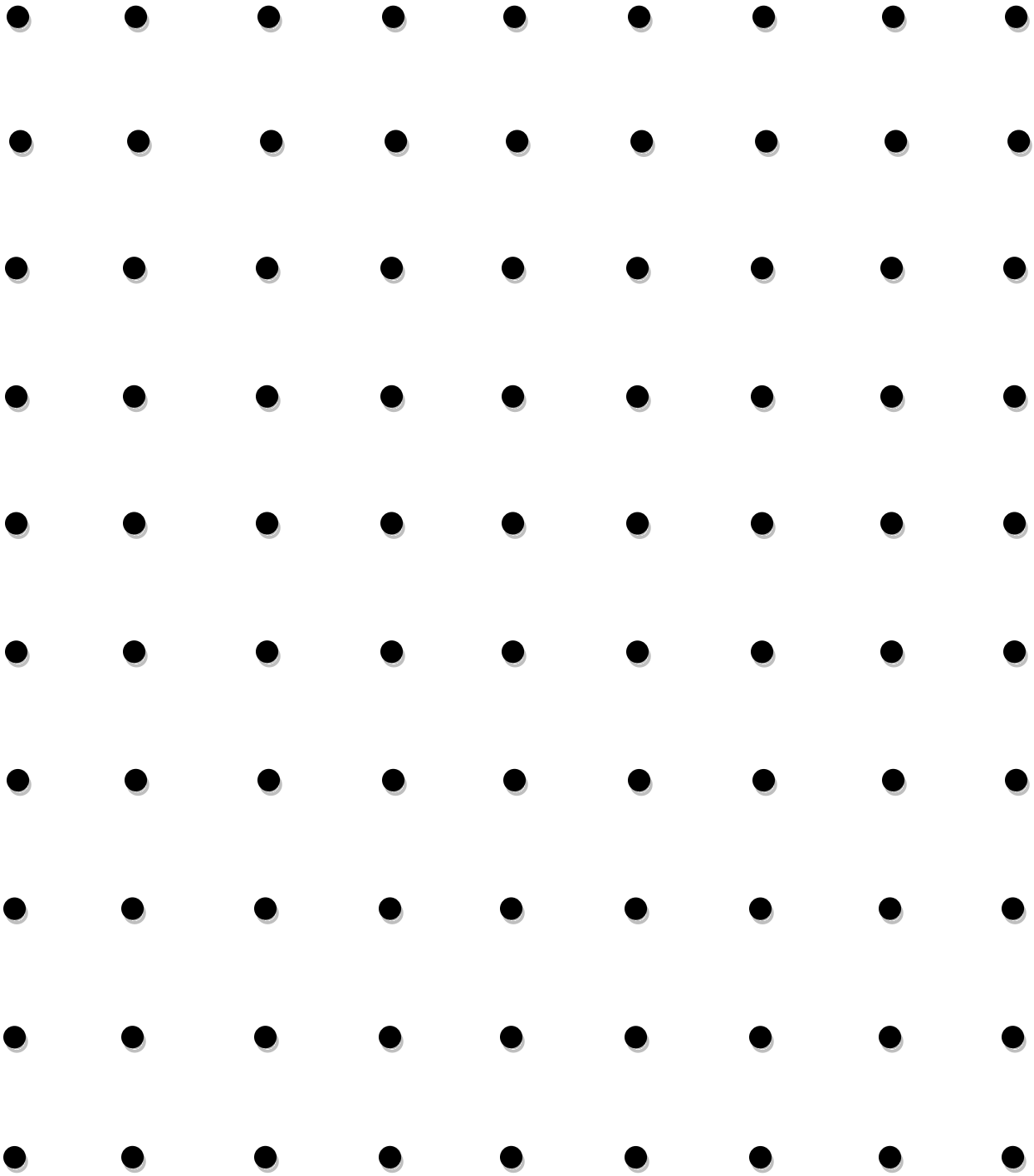
STUDENT HANDOUT (ELABORATION): Mapping the Unknown – GRID Worksheet



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STUDENT HANDOUT: Gallery Walk – Topographic Map Evaluations

Team: ____________________

1	2	3	4
Contour lines are not connected or are missing. Elevations are not listed. Landing zones are not listed.	Some contour lines are connected or are missing. Elevations are not listed. Landing zones are not listed.	Contour lines are clearly connected. Elevations and/or landing zones are not clearly labeled.	Contour lines are clearly connected. Elevations and landing zones are clearly labeled.

Comments:

Questions:

Team: ____________________

1	2	3	4
Contour lines are not connected or are missing. Elevations are not listed. Landing zones are not listed.	Some contour lines are connected or are missing. Elevations are not listed. Landing zones are not listed.	Contour lines are clearly connected. Elevations and/or landing zones are not clearly labeled.	Contour lines are clearly connected. Elevations and landing zones are clearly labeled.

Comments:

Questions:

Team: ____________________

1	2	3	4
Contour lines are not connected or are missing. Elevations are not listed. Landing zones are not listed.	Some contour lines are connected or are missing. Elevations are not listed. Landing zones are not listed.	Contour lines are clearly connected. Elevations and/or landing zones are not clearly labeled.	Contour lines are clearly connected. Elevations and landing zones are clearly labeled.

Comments:

Questions: