

Mapping Topography and Watersheds
Earth Science and Geography
Target Grade: 8th

Unit Summary: *This unit introduces students to maps and map types. Students will start the unit by identifying and explaining various map types, uses of maps and features that make a good map. Through this first lesson the students will recognize that physical maps are important for showing spatial limits of physical relief and elevation. The second lesson will tie in to the first by having students use 3D models to make 2D maps of elevation in the form of contours on a topographic map. Students will learn firsthand how elevation is represented in maps and how to read topographic maps to determine elevation at a point as well slope. In the final lesson the students will be given a topographic map of a local watershed and asked to delineate the watershed boundaries. They will be required to fall back on the skills they acquired in the previous lessons to read and interpret the topographic map. Once that have completed the first part of the exercise they will use a data set to calculate precipitation and discharge into and out of the watershed.*

Michigan Content Expectation

- E.1C Conduct Scientific investigations using appropriate tools and techniques.
- 6-G1.1.1 Describe how geographers use mapping to represent places and natural and human phenomena in the world
- 7-G1.1.1 Explain and use a variety of maps, globes and web based geography technology to study the world including global, interregional, regional and local scales
- E1.2C Develop an understanding of a scientific concept by accessing information from multiple sources
- E3.p1A Describe and identify surface features using maps and satellite images.
- E1.1A Generate questions that can be investigated in the lab or the field.
- E4.p1B Analyze the flow of water between the elements of a watershed including surface features (lakes, streams, rivers, wetlands)

Table of Lessons:



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Lesson Title- Brief Description	Learning Objectives	Michigan Content Expectations	Materials
<p>Map Types: This lesson is designed to introduce students to the various types of maps and how they are used (e.g. physical, political and thematic) and the elements that are common and important to making an effective map.</p>	<ul style="list-style-type: none"> • Identify and differentiate various maps and give the purpose/use of each type. • Identify the essential elements of maps: title, scale, north arrow (compass rose/cardinal directions), legend, etc. • Prepare and present an effective presentation that demonstrates their understanding of map types and the purpose/use of each 	<ul style="list-style-type: none"> • E.1C Conduct Scientific investigations using appropriate tools and techniques. • 6-G1.1.1 Describe how geographers use mapping to represent places and natural and human phenomena in the world • 7-G1.1.1 Explain and use a variety of maps, globes and web based geography technology to study the world including global, interregional, regional and local scales 	<p>Computer with internet, PowerPoint, and digital projector, Maps PowerPoint, Student Handouts: Grading Rubric, Maps Assessment PowerPoint Guidelines, Map Exploration Check List</p>



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<p>Topography and Contours: This lesson is an introduction to understanding and interpreting contour lines and topography.</p>	<ul style="list-style-type: none"> • Use models to represent physical features of earth’s surface • Read contour lines to identify changes in elevation • Identify and explain slope using contour line spacing • Define and calculate slope • Explain scale in terms of mapping • Use metric measurement devices in an investigation 	<ul style="list-style-type: none"> • E.1C Use tools and equipment appropriate to scientific investigation. • E1.2C Develop an understanding of a scientific concept by accessing information from multiple sources • E3.p1A Describe and identify surface features using maps and satellite images. 	<p>Contour Mapping Model: http://www.flinnsci.com/store/Scripts/prodView.asp?idproduct=15345 Or make your own: Modeling clay, play dough or even a small rock (~ 12” diameter) – this will be your 3D model of a landform. A wash basin or bucket or other container for water (should be large enough for your 3D model to be totally submerged)</p>
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		<p>Ruler – preferably metric Grease pencil or crayon 3 liters of colored water per model Contour Mapping Activity: http://www.deltaeducation.com/productdetail.aspx?Collection=Y&productId=1503&menuID= Or make your own: Foam board Bamboo skewers Pens, pencil, paper, Contours PowerPoint Student handouts (Topographic maps student</p>
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			sheet, Contour Modeling Activity, Contour Mapping Activity)
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<p>Watershed Delineation: In this lesson students will use a topographic map and their understanding about reading these maps to delineate a local watershed.</p>	<ul style="list-style-type: none"> • Identify the principles and components of a watershed and river flow system. • Explain how topography defines watershed boundaries. • Demonstrate how to use a topographic map to identify landforms that determine the topographic boundaries of a watershed. • Calculate slope and area of a watershed in the units of your choice. 	<ul style="list-style-type: none"> • E1.1A Generate questions that can be investigated in the lab or the field. • E.1C Conduct Scientific investigations using appropriate tools and techniques. • E4.p1B Analyze the flow of water between the elements of a watershed including surface features (lakes, streams, rivers, wetlands) 	<p>Colored pencils, paper and photo copies of a local topographic map. Watershed delineation PowerPoint, topographic map (Coles Creek), student handouts (How to Delineate a Watershed Using a Topographic Map, student worksheet, Watershed fluxes) attached in appendix</p>
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Safety Considerations: N/A

Resources (websites):

Flinn Scientific, Inc. – purchase contour modeling and mapping activities.
www.flinnsci.com/store/Scripts/prodView.asp?idproduct=15345

Delta Education – purchase contour modeling and mapping activities



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www.deltaeducation.com/productdetail.aspx?Collection=Y&prodID=1503&menuID=

USDA Natural Resources Conservation Service, New Hampshire – How to delineate a watershed

www.nrcs.usda.gov/wps/portal/nrcs/detail/nh/technical/?cid=nrcs144p2_015680

GIS Lounge

- Basics of a map

www.gislounge.com/map/

- To North Arrow or Not to North Arrow

www.gislounge.com/to-north-arrow-or-not-to-north-arrow/

- Elements of a map

www.gislounge.com/whats-in-a-map/

- Cartographic Resources

www.gislounge.com/cartographic-resources/

- Principles of cartographic design

www.gislounge.com/principles-of-cartographic-design/

About.com – types of maps

geography.about.com/od/understandmaps/a/map-types.htm

Mrs Travis Classroom – Types of maps

www.myteacherpages.com/webpages/TTravis/social_studies_class.cfm?subpage=648434

University of Texas Libraries: Perry-Castaneda Library Map Collection – World maps

www.lib.utexas.edu/maps/world.html

United States Digital Map Library

- Main access to the map collection.

usgwarchives.net/maps/maps.html

- Michigan state maps digital map library

usgwarchives.net/maps/michigan/

National Atlas – Printable maps

www.nationalatlas.gov/printable.html

Houghton Mifflin Harcourt: Education Place – Classroom resources: Outline Maps

www.eduplace.com/ss/maps/



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Appendix A: Unit Assessment

Answers in ***Bold italics***

Part 1

Name _____ Date _____

Maps and Topography Quiz! 100 Points total

Answer the following questions (26 points total)

- What do maps communicate? (2 points) – ***spatial information***
- What are the three map types? (3 points)
 1. ***Thematic***
 2. ***Political***
 3. ***Physical***
- What are the 7 elements that all good maps should have (7 points)
 1. ***Title***
 2. ***Legend***
 3. ***Scale***
 4. ***North arrow***
 5. ***Figure***
 6. ***Border***
 7. ***Labels***
- What is scale? (2 points) – ***the ratio of distance on a map corresponding to distance on the ground***
- What is topography? (2 points) – ***elevation and physical relief***
- What is a topographic map? (2 points) – ***a map that shows elevation and relief with contour lines***
- How is elevation shown on a topographic map? (2 points) – ***using contour lines***



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- What is a contour line? (2 points) – ***an imaginary line that represents an elevation on a map***
- What is a contour interval? (2 points) – ***the vertical distance between contour lines***
- What kinds of information do topographic maps show us? (2 points) – ***relief, elevation and landforms***

Part 2

Name _____ Date _____

Use the Oskar Quadrangle topographic maps for these questions (74 points total)

- What is the contour interval of this map? (2 points) – **20 (feet)**
- What is the elevation at point A? (2 points) - **860 (feet)**
- What landform feature is found at point B? What is the elevation? (2 points) – **hill top 840'**
- If you were walking from point C to point D, would you be going uphill or downhill? (2 points) - **Uphill**
- What is the elevation change from point C to D? (2 points) – **180 or 200 (feet)**
- What is the horizontal distance from C to D. (2 points) - **~0.9km, 3000 (feet)**
- What is the slope of line CD? (remember rise over run x 100) (4 points) - **.06 or 6%**
- What direction is Schlot Creek flowing at point H? (2 points) – **east or north east**
- How can you tell? (2 points) – **because of the “v” shape in the contour lines**
- Describe the topography at Point G? (4 points) – **a crater or a basin, kettle**
- Delineate the watershed for tributary to Schlot Creek starting at Point H. (25 points) – **see included map: Oskar_watershed_delineated_grid_area**



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- Draw a grid and calculate the area for that creek in cubic kilometers. (25 points) – **roughly 4.5 km²**

Extra credit (10 points total)

- Would it be better to build a house at point E or at point F? (2 points) - **F**
 - a. Why do you think this? - **F is flatter than E**
 - b. Describe the topography at point E and point F? - **E is a steep slope, F is flat**
- Calculate the slope from point H to point I (show your work for 8 points) ~ **1.05%**
 - a. **80/9500**

Brief description of how this unit relates to your graduate research.

My research focuses on the communication of volcanic hazards. Because the shape and features of the Earth's surface (topography) control the distribution and patterns of vegetation, stream flow, hazards and human settlement, it is essential to understand the interplay between topography and the movement of water. While topography controls water it is water that in turn sculpts and defines landscape. In Earth Science we can draw a parallel between watersheds and the constraints on volcanic hazards. It is the study of this parallel that I am attempting to explore and share in the classroom through this unit and the next unit to come.

Because many volcanic hazards are constrained by topography it is important to understand and communicate the influence of local topography on volcanic products. Furthermore, because topography and hazards are most often communicated with maps it is important to have a more than basic understanding of how spatial information is represented on maps. This unit provides the opportunity to improve my communication skills through the use of maps. It is also an opportunity for me to see weakness in the communication process and how learners can improve their map literacy skills.



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In the unit to come, students will eventually use their map skills when considering regional hazards such as flooding, landslides and point source or nonpoint source pollution. Analogue models and GIS techniques will be employed in the classroom which will allow the students and teachers the opportunity to define the hazards relevant to them. They will eventually employ a cartographic element that will allow students to produce maps to identify the spatial extent of hazard and points of vulnerability based on their individual perception.

The direction of unit discussed above will relate to my Ph.D. research through the study of hazard and risk perception, the communication of science and the improvement of map literacy. While my particular research interests focus on the communication of risk to a lay audience this unit will provide an opportunity to evaluate the efficacy of maps, topography and hazards education at a local, classroom level.