# GIS2
# THE SAND TABLE PROJECT

## INTRODUCTION

The purpose of our GIS**2** course is to provide you with multiple hands-on learning experiences that involve building, using, and applying geographic information systems to solve spatial problems.

Real world landscapes are interesting, but their complexities can pose difficult problems for the novice mapper – especially when you've never walked on the terrain under study. So, we're going to work with a landscape model that fits on a table. We can walk around it, get close to it, or step away and look at it from many different vantage points.

We're going to start by looking at and sketching the terrain in a sand table. We're going to use that sketch to help us think about what observations we want to take from the table. And then we're going to organize those observations using GIS techniques. In other words, this hands-on learning experience will help you to conceptualize a landscape and to learn the process of collecting spatially-referenced data and preparing those data for use in a GIS.

The sand table project requires a variety of skills and some labor, so we're going to pool human resources and work in teams. Lab work will be performed and lab reports will be submitted by teams (not by individuals). All team member names should appear atop the first page of each team's report. All team members will receive the same score for the team's work and report. As your professor, I will guide you through the process while also being watchful for signs of slack (a person not pulling their weight) or overload (one person doing all the work). When needed, I'll adjust the offending team member(s) "Professionalism" score(s) accordingly.

## PURPOSE *(**Why** are we doing this?)*

The purpose of the Sand Table Project is twofold:

- Lab 1 offers you a hands-on learning experience that will help you learn how to *conceptualize a landscape* and *collect spatial data*; and
- Lab 2 will help you gain experience *using your data in a GIS and making a map*.

Please know that each lab is designed to help you learn different things, so the purpose section for each report should be written differently.

## OBJECTIVES *(**What** in general are we supposed to do?)*

You've been given a wooden table containing sand and rocks that were shaped into a physical terrain model. A few wooden buildings have also been placed on the terrain.

- For Lab 1, your objectives include thinking about the terrain, planning a data collection mission, reviewing your plan with me, and then collecting your spatial data.
- For Lab 2, your objectives include building digital datasets that accurately represent 'entity' locations and 'field' variations, and building a scaled map (using ArcGIS Pro) that represents your sand table.

## ADVICE FOR LAB 1

Find the outside corner of the sandbox associated with 0 cm E, 0 cm N on the Sand Table Coordinate System. Use this point like a survey mark (a horizontal datum point against which all your horizontal distances can be spatially referenced). Let the Easting axis run parallel with the short side of the table. Let the Northing axis run parallel with the long side of the table.

Prepare, collect, store, and map all data using the 'decimal centimeter' as your unit of measure. Yes, ArcGIS is capable of handling mixed units (e.g., inches, cm, US feet, international feet, meters), but it'll be much easier if you use just one unit of measure of measure for all your x, y and z data – the decimal centimeter.

## METHODS FOR LAB 1 *(How, specifically, are we accomplishing the objectives?)*

1. Observe your sand table, then identify and name any salient landforms;
2. Draw a detailed sketch of your sand table and the salient landforms you named. Be sure to:
   a. Annotate your sketch with landform names and any descriptive information.
   b. Label your coordinate system axes (Easting, Northing) and draw a north arrow;
   c. Find the horizontal datum point (where x,y = 0,0) of the Sand Table Coordinate System and plot/label this very important point;
   d. Choose, plot, and label your vertical datum point (where z = 0);
3. Think about how to represent each discrete instance of a building;
4. Think about how to represent elevation as it changes continuously across the landscape;
5. With respect to your landforms, choose an appropriate ***minimum mapping unit (mmu)***;
6. Based on your mmu, calculate the ***spatial sampling interval*** for collecting elevation data;
7. Identify the methods and tools your team uses to take and record your data.

Question 1: Observe the sand table. Describe the average *aspect* of the terrain surface (i.e., find the highest region on the landscape, then report the general downhill direction (N, NE, E, SE, S …) that rainwater would tend to flow if a miniature rainstorm occurred over the table).

Question 2: What are the names your team has given to the salient landforms on your landscape?

Question 3: Which of your salient landforms has the shortest horizontal dimension (i.e., shortest length or shortest width; ***not*** the shortest height). What is the length (in cm) of that shortest dimension?

Question 4: The shortest horizontal dimension of a landform is sometimes called its semi-minor axis (the longest is called its semi-major axis). The semi-minor axis of your landform serves as your Minimum Mapping Unit (MMU). Given your MMU, what should be your horizontal *sampling interval* (in cm)?


**I want to help you avoid mistakes, so meet and discuss your plan with me before starting step 8.**

8. Collect your data.

Question 5: Build a captioned table in your report that provides the header and first 10 rows of your elevation field data (Table 1). Build another table (Table 2) that provides the header and all the records of your building entity data.

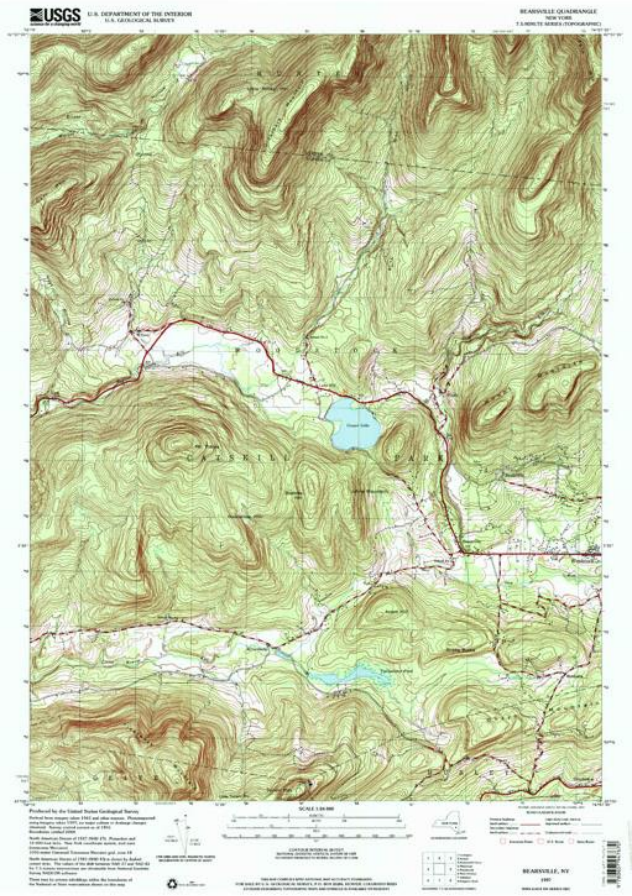
Question 6: Did you modify your horizontal sampling interval as you collected your elevation data? If so, then report the new sampling interval (in cm).

Question 7: Did you have to sample your population of buildings? Consult your notes and explain.


and skip to the **DELIVERABLES** section for information about writing your first lab report.

## METHODS FOR LAB 2

9. Use Microsoft Excel or Notepad to organize your spatial data into files (you can use and share a Google Sheet, but it will eventually have to be converted into a file in XLS or CSV format). Close Excel.
10. Next, use ArcGIS Pro to **Open the SandTableProject.aprx** project in your GIS2/Labs folder. Check to make sure your project is still connected to your GIS2_Lab2 folder and connected to your GIS2_Lab2.gdb geodatabase.
11. Open the map called **Layers**. It should contain one polygon feature (light yellow fill) that represents the inside of the sand table.
12. Find, setup, and run the **Analysis > Tools > XY Table to Point** tool twice (once for building feature and again for elevation spot heights).
13. Label and symbolize your point data to help you check your work; go back to Task 9 as needed to correct any blunders or errors in your building or elevation data;
14. Find, setup, and interpolate a raster surface of elevations from your spot height point features;
    i. 0.5 cm cell size
    ii. Use **IDW** (Bolstad 2019, p529-534), **Spline** (Bolstad 2019, p534) or **Natural Neighbor** (not described by your textbook, but in the Help menu) to interpolate your surface
15. Next, use your new surface and the **Contour** tool to derive isolines that represent the field of elevation in your sand table.
16. Open the project layout called **Sand Table map layout**; finish the layout by adding any necessary but missing map elements (remember what you were taught in GIS1 and/or Cartography).
17. Print your layout on 11x17" paper.




Question 8: How many points (buildings and spot heights) did you collect?

Question 9: Which interpolator did you use to convert your spot height features into a gridded raster surface? Consult your text and the help menu to help you explain how your method works.

Question 10: Revisit the sand table, review your sketch, and inspect your map. Which parts of your map turned out better/worse than expected or hoped? Explain successes and failures. For example, where in your outputted digital elevation model (DEM) best represents the terrain in your sand table? Where worst? Where do your building features best represent the building entities in the table?

Question 11: If you had to do this project all over again, then what would you change or do differently to improve either your group's efficiency and/or your map quality? Explain.

## ADVICE FOR LAB 2

Finish building your layout by making design choices that mimic a USGS Topographic map. Your map will have many fewer layers than a real USGS topo map (no forests, rivers, mines, roads, etc.), but you have enough data and enough map elements to achieve a similiar look (i.e., the map area is big, the title font is small, contours are brown, salient landforms are labeled, symbols are defined, the scale bar is visible but not obtrusive, etc.). Include:

1. a (small) title;
2. names of authors, the date(s) your data were collected, and the date your map was published;
3. a (small) north arrow;
4. labeled axes;
5. a symbol key (to provide map readers with definitions for your symbols/colors);
6. the map scale (1:3) has already been set for you (Kimerling et at., p24).
7. and labeled landforms (go back to your your sketch).

## DELIVERABLES

Write a well-written and proofread report for Lab 1 and another report for Lab 2. Each report should be typed and printed on letter size (8.5" by 11") paper. Before drafting your report, set all page margins to be 0.7", except for the left margin; set the left margin to 1.2". Include page numbers on every page. Set the normal font face to be Bookman Antiqua, Bookman Old Style, or Georgia; never use Times New Roman. Set the normal font size to be 11 points. Use 1.5 line spacing throughout. All section headings should be in **bold** face and left-justified. Report the names of all group members, the date, and the lab name atop the first page. Don't waste paper by including a cover sheet. Each report should include five sections and section headings:

1. Purpose
2. Objectives
3. Methods and Data
4. Results and Answers; and
5. Summary

For each lab, write a concise statement of purpose in your own words that answers the question: *Why are we doing this lab - what are we supposed to learn*?

Next, identify the objectives using your own words by answering the question: *What tasks, in general, are we supposed to accomplish during this lab*?

Next, describe the methods and data you used (i.e., *How, specifically, did we accomplish each objective? Software? Datasets? Equations? Steps?*). If describing a particular method using text becomes cumbersome, then try explaining it by using a worked example, drawing a sketch, building a diagram, or inserting an equation.

Your Results and Answers section should contain any data tables, images, or results as well as the answers to all the questions that were posed during the lab. All tables (Insert > Table) must be numbered sequentially and captioned; table captions are to be placed above the tables they describe (e.g., Table 2-1 on page 53 in Bolstad, 2019). All figures (Insert > Picture) must be numbered sequentially and captioned; figure captions are to be placed below the figures they describe (e.g., Figure 2-33 on page 53 in Bolstad, 2019). When equations are used (Insert > Symbols > Equations), be sure to define each term (e.g., Equation 12-1 on page 532 in Bolstad, 2019).

Use the Summary section to describe how well you think you achieved the purpose of the lab. Feel free to identify anything that you learned, found interesting, or found difficult. Feel free to describe any moment when your mental 'light bulb' glowed brighter (or flickered). You may also use the Summary section to ask me questions.