Using surfaces in ArcGIS Spatial Analyst

- Hillshade (typically as semi-transparent overlay)
- Aspect (8 different directions only)
- Contour (lines)
- Slope (degrees or percent, may need elevation conversion factor if elev. is in feet)
- Curvature (change of slope i.e. change of change of elevation)

Slope & Azimuth

...terrain surface is characterized by inclination (slope) and orientation (azimuth)

Digital Elevation Model (DEM)

- Digital Terrain Model (DTM)
- Topography: Elevation (ft. or meter, sometimes: elevation in feet, horizontal distances in meters!)
- US Geological Survey:
  - 7.5' maps (quads), 10 m, 30 m; 90 m
- National Elevation Dataset (NED): 10 m
- Shuttle Radar Topography Mission (SRTM): 90 m
- Raster values: large integers (1243 ft) or float (543.2 m)
Slope

- Based on elevation difference of cell to elevation of surrounding cells
- Gradient at cell (center)
- Problem: if X/Y are in meters, elevation (Z) is in feet
- Solution: multiply elevation by 3.280 (Z-factor)
- Tool: Spatial Analyst tools Surface - Slope

Aspect

- Direction of maximum rate of change at cell’s center
- Looking down to the maximum slope (geology: dip direction)
- In degrees (0 - 360) from North, circular data type
- Flat areas (0 slope): encoded as -1
- On floating point DEM, a very small slope (< 0.01) should be filtered to 0
- Default colors (can be changed):
  - Visually reduced into the 8 major directions
  - Flat areas shown grey
- Tool: Spatial Analyst tools Surface - Aspect

Hillshading

- Trick to fool our eyes to see 3D relief
- Simulate Sun from direction (0-360) and angle (0-90)
- Creates a grey scale raster (0-255, black -> white)
- Gotcha: Sun must be in the North (270 - 90), otherwise relief looks inverted (human evolution: sun from above)
- 10-50% transparent, drape over DEM
- Play with contrast and brightness settings
- Tool: Spatial Analyst tools - Surface - Hillshade
- `geoIS88\data\Hillshade Tools - ArcGIS 9.3 special hillshade methods` (not sure if they still work in ArcGIS 10 ...)

Viewshed

- Needs a shapefile with points or lines
- Which cells can be seen from these points?
- Shoots rays from point to each cell, check for intersect with terrain
- Tool: Spatial Analyst tools - Surface - Viewshed
- Observer points tool:
  - Which points can see other points? (limit 16 points)
  - Can include height of point (“towers”), limit azimuth, ...
  - Creates a table only
Green cell: can be seen from 1 (or more) point
Red cells: view from point is obstructed (0)

Neighborhood function tools

- go through all cells (locations) of input raster one by one
- for each cell, do some sort of math involving its “neighbors”
  - e.g.: calculate the SUM of all cells “around” it - write that one value into output raster - go to next cell
- different neighborhood shapes (Geometries)
  - use a kernel (3 x 3) to filter raster (mean => low-pass filter)
- Spatial Analyst Tools - Neighborhood

Focal Statistics tool
Neighborhood “geometry”:
- green current cell, yellow: (red) neighbor cells

Related Tool: 3D analyst Toolbar - Create Line of Sight
What type of math (statistics) should be done with the neighborhood cell’s values?

Variety: how many different (int) values?

Mean: average of (int, float) values

Statistics type for Focal Statistics tool:
- **MEAN** — Calculates the mean (average value) of the cells in the neighborhood.
- **MAJORITY** — Calculates the majority (value that occurs most often) of the cells in the neighborhood. (INT only)
- **MAXIMUM** — Calculates the maximum (largest value) of the cells in the neighborhood.
- **MEDIAN** — Calculates the median of the cells in the neighborhood.
- **MINIMUM** — Calculates the minimum (smallest value) of the cells in the neighborhood.
- **MINORITY** — Calculates the minority (value that occurs least often) of the cells in the neighborhood. (INT only)
- **RANGE** — Calculates the range (difference between largest and smallest value) of the cells in the neighborhood.
- **STD** — Calculates the standard deviation of the cells in the neighborhood.
- **SUM** — Calculates the sum (total of all values) of the cells in the neighborhood.
- **VARIETY** — Calculates the variety (the number of unique values) of the cells in the neighborhood. (INT only)