Session 3: Advanced GIS functions

GIS extensions

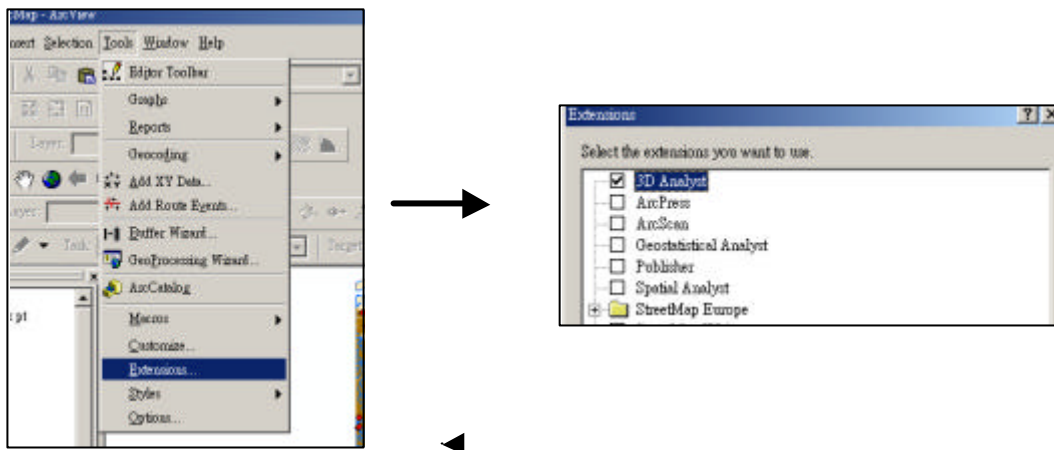## 3D Analyst

Task 1: Construct a TIN

Step 1: Create a new map file in ArcMap

- Activate the ArcGIS programme: **" Start → Program → ArcGIS → ArcMap"**
- **Choose " A new empty map"** when the start up dialogue prompt up.
- **Click** the icon **" Add Data"** ⬇ from the toolbar.
- Go to the path *"C:\\yuikee\Session3\3DAnalyst"* **to add the following shapefiles, they are "sites.shp', "build up area.shp", "contour.shp", "spot_ht.shp", " relief.shp", "hydro.shp" and " road.shp".**

Step 2: Activate "3D Analyst" extension in ArcMap

To create a TIN file please follow the steps below.

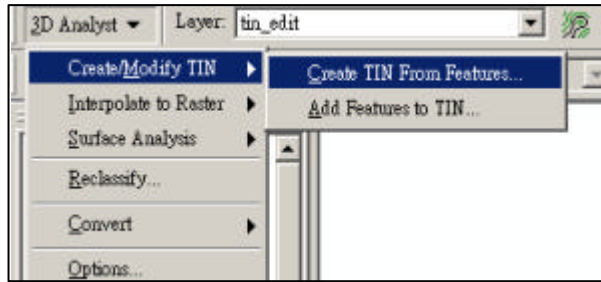- **click " Tools" → " Extensions" → choose "3D Analyst"** and then close this window.
-

- A toolbar of "3D Analyst" will appear as shown below. Please check **"View → Toolbars" and look for "3DAnalyst"** if the toolbar does not show up.

Step 3: Create the TIN

- **"3D Analyst" toolbar** → Click "Create/Modify TIN" → Choose "Create TIN From Features"
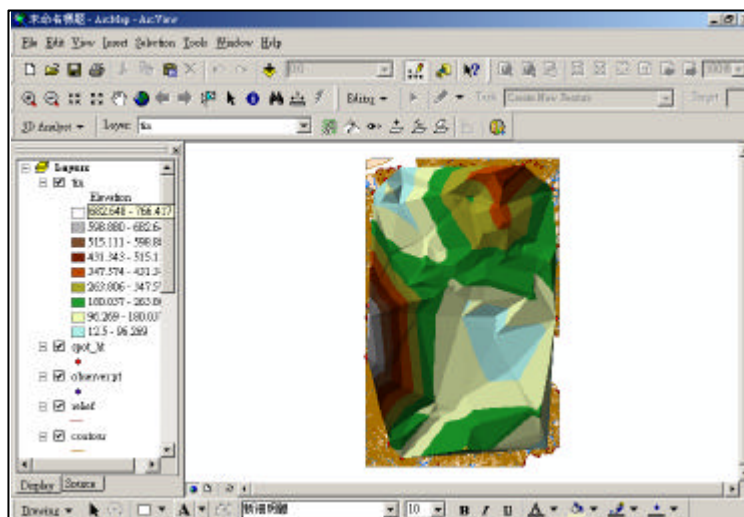

- In the **"Create TIN From Features"** dialogue box → choose **"spot_ht"** from the column of *Layers*. This means the **"spot_ht"** layer will be used to create a TIN.
- choose **"SPOT_HT"** as the Height Source from the column of *Settings for selected layer.*
- Please **save** your new TIN file in the text box named **"Output TIN"** → *C:\yiukee\3DAnalyst\tin* → **Click "OK".**
-
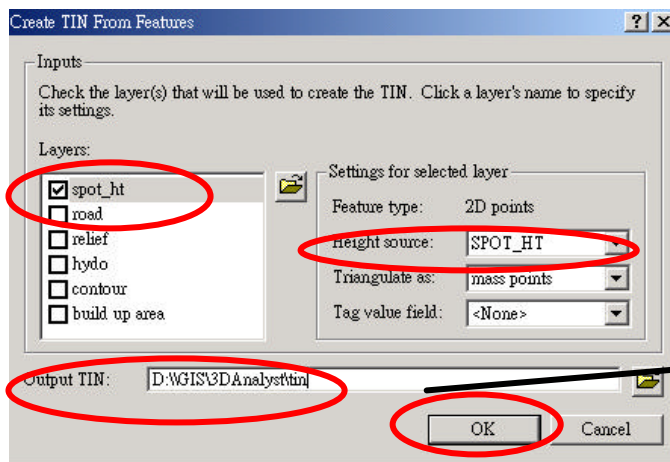
- **A TIN will be created as shown below.**
-

Task 2: Edit TIN by using contour lines

In Task 1, you have prepared a TIN file by using spot heights. The resulted TIN map is generalized into rigid lines which cannot reflect the topography of Mui Wo comprehensively. Hence, we will try to refine the TIN by using contour lines.

- In the **"3D Analyst" toolbar** → **click " Create/Modify TIN"** → **Choose " Add Feature to TIN"**
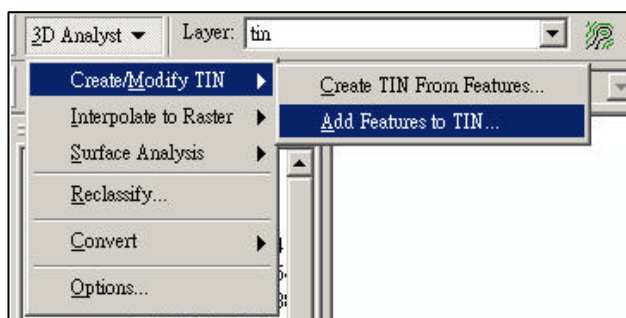
- In the **" Add Feature to TIN"** dialogue box → **Choose "tin" in the " Input TIN"**
- **Choose "contour"** from the column of *Layers*. This means the 'contour' layer will be used to refine the TIN.
- **Choose " CON_HT"** as *Height Source* and *Triangulate* **as " hardline"** from the column of *Settings for selected layer*.
- Please **save** your new TIN file in the text box named **" Output TIN"** → **C:\yiukee\3DAnalyst\tin_edit** → **Click " OK".**
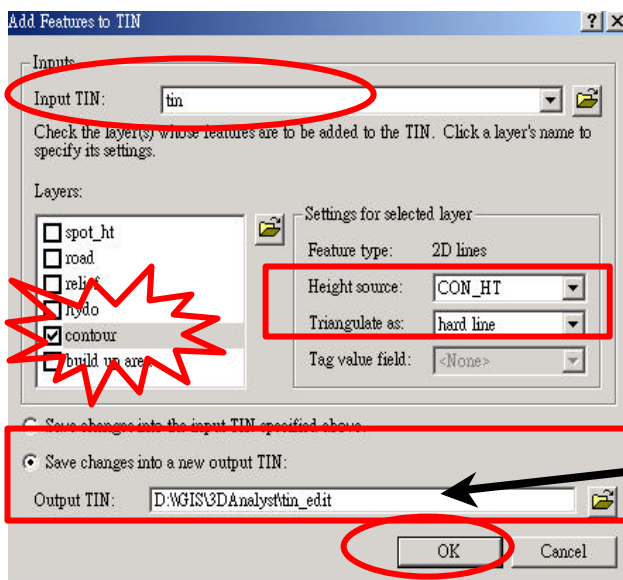
C:\\yiukee\Session3\3DAnalyst\?

- **The result is shown as below:**
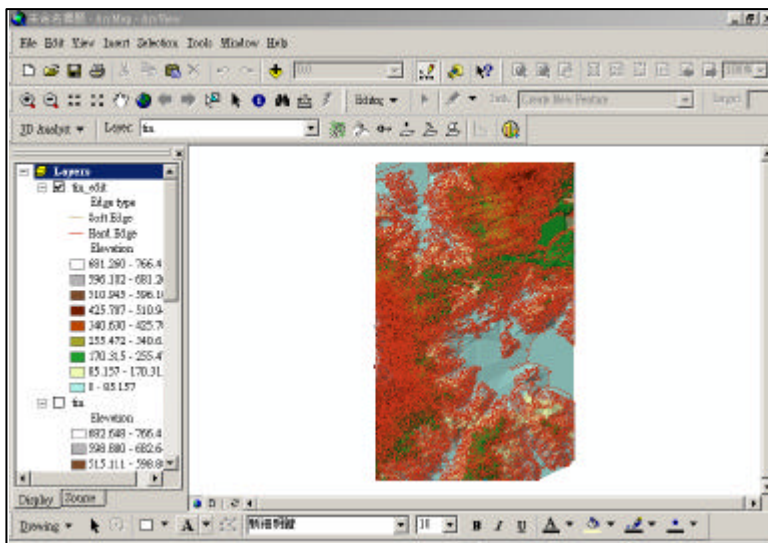
- As there are too many contour lines on your map, it is hard to see the topography clearly, so we try to fade out contour lines by the following steps.
- **Right click "tin_edit" → Click "Properties" → In the Layer Properties box, click "Symbology" → Check out "edge types" → Click OK**

- **The edited TIN without contour lines on top will be shown as below:**
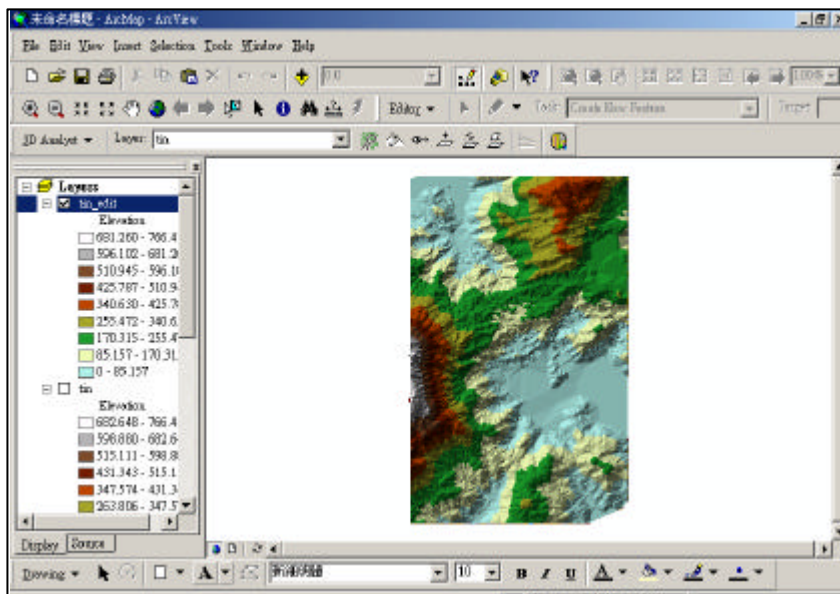
- **Try to put the " river" layer on the top of the TOC, then you can see river pattern lying over the terrain.**
-

Quiz

How can you find out the location with 132.4m? (Hints: icons on the tool bar and dialogue boxes can give you a hand.)

Exercise: River Studies

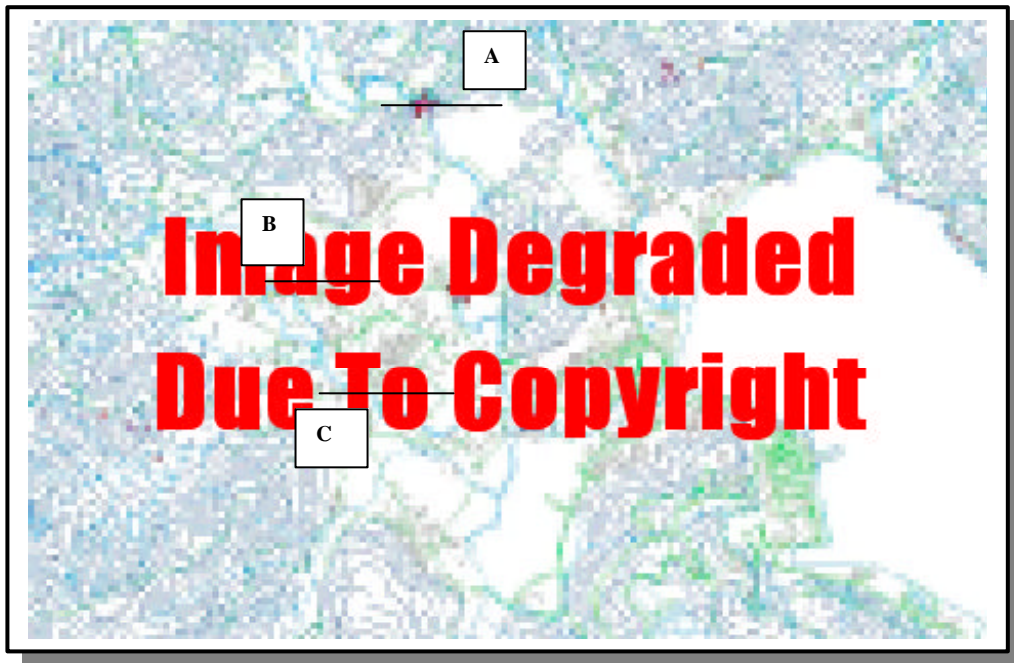- A group of S4 students had fieldwork in Mui Wo last Saturday. They studied the morphology of River Silver and examined the water quality at Point A, B and C. Now they are using GIS to process and present their results.

Task 1

- Add Point A, B and C on the map by using **Editor**

Steps: Adding features into the map

- **Open the Editor toolbar → View → Toolbars → Editor**
- **Click " Editor" → Click " Start Editing"**
- In the Editor toolbar, activate **the 'sketch tool' function by click the icon**
- Your **task is** to **" Create new features"** and the **target is "sites"**, so the toolbar should be liked this :
-

- **click → the mouse will change to → point on the location where your study site is located → a blue point will be shown on the map**
- **add all study sites on the map →** When you **finish → Click "Editor" → Click "Save Edits"**
- **Check the attribute table of site → Right click 'sites" layer → Click "Open Attribute Table"**

- A **table prompt up** → Under the **field " id"**, **change the number according to this order 1 –3 (see Table 1)**→ **Add the data provided** under the **field "Name"** and **other attributes (See Table 1)** to the attribute table

Table 1   Water Quality of Different Sampling Points

Sampling Points Parameters	Tributary of River Silver		
	A (id : 1)	B (id : 2)	C (id : 3)
DO (mg/l)	7.9	6.5	2.0
pH	7.0	6.4	8.4
Conductivity (ppm)	9	500	1090
Salinity (‰)	0.0	0.3	4.0

- When you **finish** → **Click " Editor"** → **Click "Save Edits"** → **Click " Stop Editing"**

 *** Identify the site by using the icon

   Task 2
- Add hyperlinks and photographs on the map
   Steps: Add photos on the map

 - **Click   on the site**

 - **Right click site on the identify window → choose "Add hyperlink" → A
   box pop up → select "link to a document" → choose the file in the path
   "C:\\yiukee\3D Analyst\Stream Quality\Photos"**
 - To **display the photo → click   → Click the site**
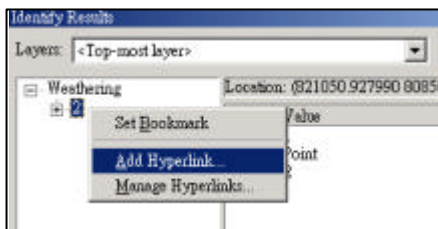
Task 3 Study the river profile
- **Click the icon "Interpolate Line"   → ick Point A, follow the river morphology
and draw a line from Point A to C → double- click to stop digitizing**

- the result will be shown as below:
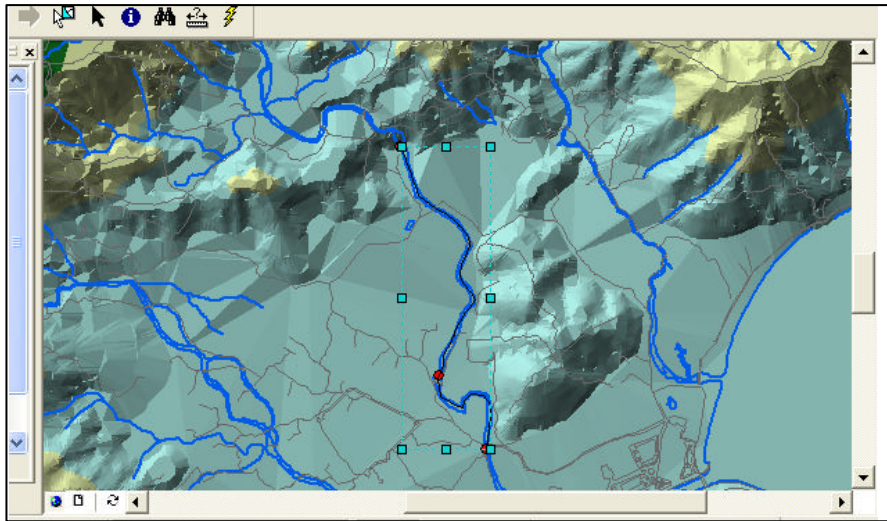
- **Click the icon 'Create Profile Graph'** ⊵ **→ A river profile graph is created.**
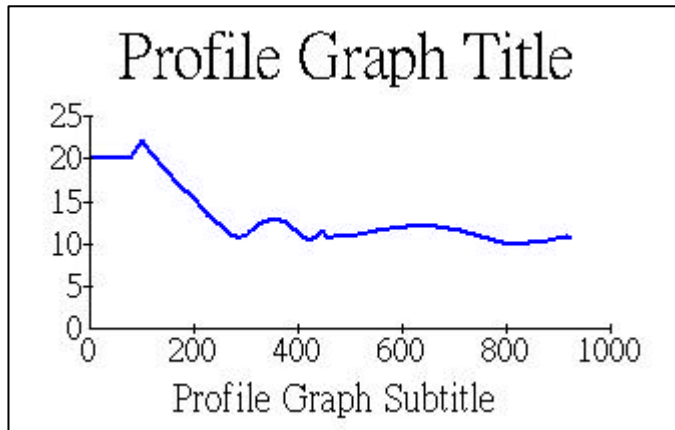
Task 4

Discussion

Prepare related questions for students by using the TIN model

Question 1

_____

_____

Question 2

_____

_____

Question 3

_____

_____

Question 4

_____

_____

Spatial Analyst

Task 1: Start the program and open the map document

- Activate the ArcGIS programme from "**Start → Program → ArcGIS → ArcMap**"
- **Choose " A new empty map"** when the start up dialogue prompt up.
- **Double click 'Browse' → Open the map document** under the path **"C:\\yuikee\Session 3\Spatial Analyst\API_Map"** → Click **" OK"**

-

Task 2: Calculating Straight Line Distance, Allocation and Direction

Step 1: Activate "Spatial Analyst" in ArcMap

- **click** "**Tools**" → "**Extensions**" → choose "**Spatial Analyst**" and then close this window.

-
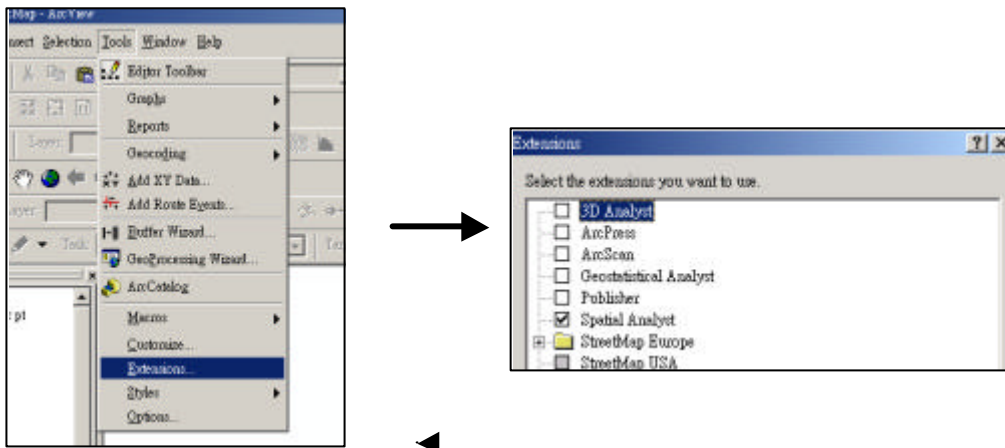
- A toolbar of "Spatial Analyst" will appear as shown below. Please check "**View** → **Toolbars**" and look for "**Spatial Analyst**" if the toolbar does not show up.
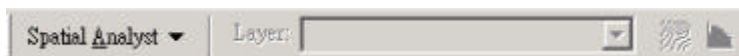
Task 3: Using Inverse Distance Weighted (IDW) for interpolation

- [1]"**Spatial Analyst**" toolbar → Choose "Interpolate to Raster" → Choose "Inverse Distance Weighted"
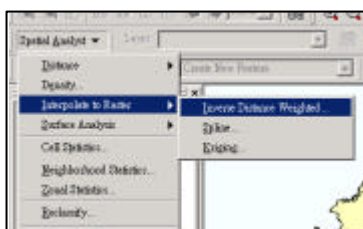
- [2]A box prompt up, **change the values as below:**
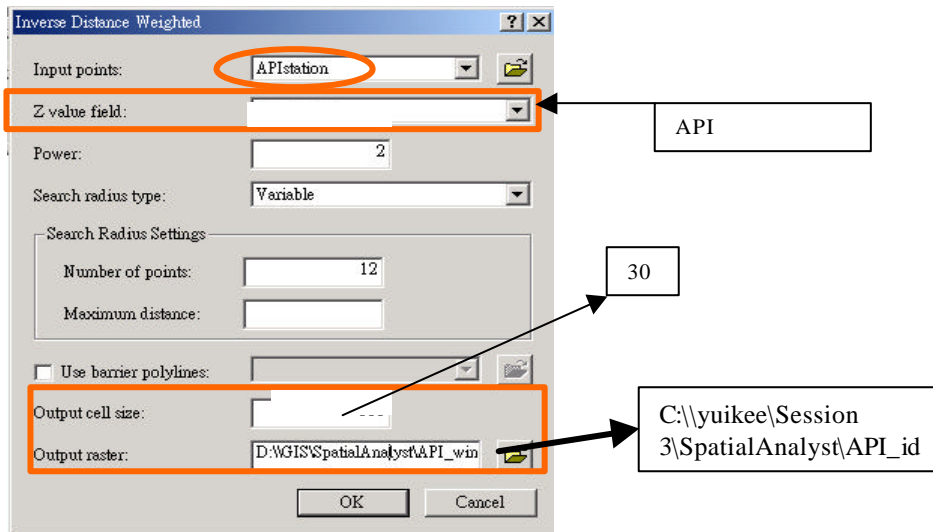
- [3]**Click "OK"** and wait for minutes during calculation
- [4]Click the layer of 'idw of APIstation', choose 'Layers properties' → click **'Display'** → choose '**Transparent'**, **change the percentage of transparent into 20%**
- [5]**The results will be shown as below**:

Discussion

1. Which location has the highest API?
2. What are the land uses in (a)?
3. Suggest the possible measures to alleviate the problems of air pollution in (a)

Exercise

✍ *Create a TIN model by using map data B20000*

Demonstrations and practice: Applying GIS in teaching AL curriculum

Brainstorming exercise

The list below is the main themes you have to teach at Advanced Level. For each, try to think about a teaching or learning activity which may make use of GIS:

> *For the detailed syllabus, go to Education and Manpower Bureau (www.emb.gov.hk)   English   Kindergarten, Primary and Secondary Education   Curriculum Development   Personal, Social and Humanities Education   Curriculum & Syllabuses   Geography   Geography (Advanced Level)*

Theme	Teaching/Learning Activity
Natural Landscapes	
Climatic System	
Energy budget & flow - insolation and temperature	
Atmospheric moisture - condensation and precipitation	
Atmospheric circulation - pressure and wind	
Climatic variation - climatic types	
Landform System	
Plate tectonics -plate movement and tectonic landforms	
Drainage basin - water cycle and basin subsystems	
Biotic System	
Ecosystem - energy flow and nutrient cycles	
Soils -soil forming processes	
Vegetation - plant ecology and natural vegetation	
Biomes - vegetation response to environment	
People-environment Relationships	
Tropical rain forest - deforestation and afforestation	
Tropical desert - human adaptations and desertification	

Agricultural Landscapes	
Farming systems - agroecosystems and farming types	
Agricultural location - von Thünen and Sinclair models	
Impact of urbanization and industrialization - farming changes	
Farming hazards - flooding and droughts	
Urban and Industrial Landscapes	
Urban functions and hierarchy - functions of cities and Christaller model	
Urban structure - urban land use models	
Manufacturing location - Weber model	
Urban problems - housing and transport problems	
Environmental impact - pollution and environmental changes	

Creating your own step-by-step manual

Exercise 1

Your Advanced Level students should be capable of manipulating data with the GIS. Now try to prepare a map showing the close relationship between the location of most recent major earthquakes and the plate boundaries. Work out a detailed step-by-step manual for your students:

1. Switch on your computer.

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

10. _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Using GIS in field trips and project-based learning

Example 1

Ping Chau Heritage Park - Rural Sustainable Development

Chinese International School

Project Aims

1.   Provide a Geographic Information System (GIS) for an inventory of the cultural heritage assets (buildings and other structures) found on the island of Ping Chau. This GIS would catalogue all structures, their state of repair & use, and most importantly, indicate their level of vulnerability in terms of permanent loss.

2.   Develop a "sustainable use of the island's cultural heritage plan" and submit it to the relevant Hong Kong Government Authorities with the aim of facilitating them in establishing "protective guidelines" such as those in place for the Marine conservation.

3.   Establish on going monitoring of the island's cultural heritage assets.

Project Details

1.   Each building/structure on the entire island will be inventoried, by:

    i)   Being digitally photographed
    ii)   Being Geo-coded, using GPS
    iii)   Recording building/site attributes, such as
    - Building materials
    - Age
    - Current/past use
    - Ownership
    - Date of construction
    - Vulnerability assessment
    - Evidence of change
    - Other notable features
    iv)   Recording current condition of the building

2. Data gathering and presentation will involve the following hardware and software:

    - Digital map of the island
    - Arcview Software 3.2
    - GPS
    - Digital Camera
    - ArcPad/iPac

3. Summarizing of the data will be in the form of thematic maps which will help identify relationships between current use and vulnerability (high risk areas), provide day trippers with an essential tool to appreciate the cultural assets, provide base line data which can track change on the island and facilitate the formulation of a long term "sustainable use plan".

4. A "Cultural heritage assets" booklet will be produced for interested parties, such as the current landowners, governing bodies and visitors. The booklet would include photographs and relevant maps.

Project Participants and Time Line

1. A pilot project will be undertaken by a small group of Year 11/12 CIS students during the school's October Project Week, October 13 – 17, 2003. The purpose of the pilot project is to develop the GIS methodology which will allow the completion of the project. A small sample of building in one village will be selected to inventory.

2. In December of 2003, the CIS Year 9 students (110 in total), under "Humanities Department" direction, will undertake the island wide cultural heritage assets inventory, which will then be used to provide a baseline for project development.

3. The Chinese International School Year 12/13 Geographers (30 students) who currently are involved in field work on the island[1] , will formulate a "Sustainable Use of the Island's Cultural Heritage Assets" Plan, for submission to relevant authorities. The plan will be based on empirical data.

4. Monitoring and up dating of the island's cultural heritage assets will be done by the Year 9 Humanities students on an annual basis.

Funding and Leadership

1. The government of HK has recently announced a "Sustainable Development" fund in which schools can apply. The purpose of such a fund, as stated by the government is to facilitate research projects which are "sustainable in nature" and encourage local community's to put in place sustainable practices. It would be the intention of this project to apply for such funding for the purpose of purchasing required equipment to undertake the field research, for communicating and publicizing the project's research to all relevant interested parties and to establish a permanent mechanism which would ensure sustainability of the cultural assets found on the island.

2. Chinese International School would initiate and undertake the steps in establishing the cultural assets inventory for the island. Long term viability of the project will need the support and help from the "island community" who still maintain links with their island property. It is therefore essential that the island community eventually take "ownership" of the project at an appropriate time for "indefinite" management.

---

[1] http://www.cis.edu.hk/Sec/ss/Geography/IB/fieldwk/pingchau.htm

Data Fields and descriptions

Fields	Description
Building Number	Assign numbers to the buildings on the Arcview map, then record data according to the assigned numbers.
Function	State the use of the building. This can be classified into a few groups: Residential (R), Commercial (C), Religious (Re), Utility (U). If it is multifunctional state all the letters that apply, such as "RC".
Building Materials	State the main type of building material. This can be classified into different groups: Sedimentary rock (SR), Concrete (C), Granite (G), Mixed (M).
Walls?	State the number of walls that are still *completely* intact (The outer structure). (0, 1, 2, 3, 4)
Roof?	State the material used to build the roof (Steel (S), Tiles (T), Corrigated asbestos sheets (A)). (If the roof is no longer standing, write None (N).)
Locked?	State if the doors are locked. Yes or No.
Evidence of use?	Look for evidence (food, dishes, toothbrush etc.) that shows the building has been used recently. Yes or No.
Evidence of repair?	Yes (new windows or doors, concrete walls, 'mendings' on the walls, extentions) or No.
Floors?	Look at how many floors there are. 1 (ground floor), 2 (another floor including ground floor), or more.
Plumbing?	Yes (pipes leading to the house) or No.
Cistern?	Yes (cistern outside house) or No.
Photo – exterior, interior and notable features	Take a photo of the front of the house, another for the interior (if possible) and one more for a special notable feature. When collecting the data, just note down the number of the digital photo (from the digital camera).
Notable features	State any notable features (if any) of the building. Choose one and take a photo. (Example: archways, temple carvings, barred doors etc.)

Example 2

Hong Kong Victoria Harbour Through Time Tunnel

Wah Yan College, Kowloon