# 明愛陳震夏郊野學園
## Caritas Chan Chun Ha Field Studies Centre

# Urban Microclimatic Studies in Central

**Student Name: _____**       **Group No.: _____**

**Course Date:         _____**

## ■ OBJECTIVES

Knowledge:  -   To investigate the relationship between the urban microclimate and urban environments

-   To study the physical and human factors leading to Urban Heat Island effect

-   To assess the mitigation and adaptive measures tackling Urban Heat Island effect

Skills:  -   To use different field equipment to collect microclimatic data

-   To use different data collection methods to assess the urban environments

-   To draw graphs to show the relationship between microclimate, urban environments and distance from the city centre

Value:  -   To raise public awareness to the Urban Heat Island effect

-   To understand the impacts of urban development on the ecological environment and our responsibilities

-   Be aware the challenges to national security imposed by global climate change due to urban development

## Relevance to the DSE geography curriculum

- Compulsory Module 7: Climate Change – Long-term fluctuation or irreversible trend?
- Elective Module 2: Weather and Climate

# STAGE 1 PLANNING & PREPARATION

## ➤ Key point of topic

To investigate the relationship between the urban microclimate and urban environments.

## ➤ Prior knowledge

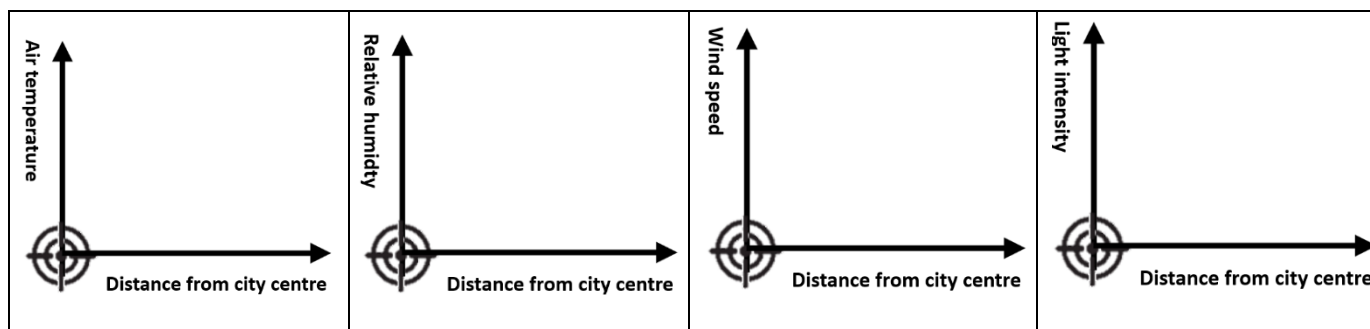1. How are microclimate of urban and rural areas different?

| Annual mean | Air temperature | Relative humidity | Wind speed | Light intensity |
|---|---|---|---|---|
| Urban area | Higher / Lower | Higher / Lower | Higher / Lower | Higher / Lower |
| Rural area | Higher / Lower | Higher / Lower | Higher / Lower | Higher / Lower |

2. List the factors contributing to Urban Heat Island effect.

## ➤ Hypothesis setting

Based on the factors mentioned in the "Prior knowledge" and Map 1 (P.12), show your hypothesis in graphical form.

**Hypothesis:** With increasing distance from the city centre, the urban microclimate would follow the trend below.

## ➢ **When to collect data?**

| | |
|---|---|
| Date: _____   Season: _____<br><br>Time: _____ to _____ | What factors would you consider in choosing the fieldwork date? |
| 1. Any weather warnings & signals issued by the Hong Kong Observatory in the **past three days**?<br><br>☐ Tropical cyclone warning signals   ☐ Rainstorm warnings   ☐ Frost warning<br><br>☐ Cold weather warning   ☐ Very hot weather warning   ☐ Other:_____ | |
| 2. Is today ideal for fieldwork of this topic? Why? | |

## ➢ **Where to collect data?**   *(refer to Map 1 on P.12)*

| | |
|---|---|
| Is Central an ideal field site of this topic? Why? | What factors would you consider when choosing the field site? |
| Sampling method is used in setting the data collection points *(details on P.17)*:<br><br>Refer to Map 1 on P.12. Set field sites 1 to 8 **along the Central-Mid-Levels Escalator and Walkway System**.<br><br>➔ _____ sampling is applied. | |

➢ **What data to collect and how to collect the data?**

| | Items | Primary data collection methods [A-I] *(see Table 1)* *(may choose more than one)* | Equipment [1-7] *(see Table 2)* *(if needed)* | Operational precautions |
|---|---|---|---|---|
| **Microclimatic elements** | Air temperature | | | |
| | Relative humidity | | | |
| | Wind speed | | | |
| | Light intensity | | | |
| **Urban heating factors** | Vegetation cover | | | |
| | Aspect ratio in urban canyon | | | |
| | Flow of vehicle | | | |
| **Others** | Land cover materials | | | |
| | Land use | | | |

Table 1 Primary data collection methods *(details on P.16)*

| A) Observation | B) Measurement | C) Counting | D) Category | E) Distribution (mapping) |
|---|---|---|---|---|
| F) Scoring | G) Field sketching | H) Questionnaire | I) In-depth interview | |

Table 2 Equipment for fieldwork *(Make sure you know how to use them correctly before fieldwork.)*

| Equipment/ tools used in the fieldwork | | |
|---|---|---|
|  |  |  |
| 1.  light meter | 2.  thermo-hygrometer | 3.  anemometer |
|  |  |  |
| 4.  laser distance meter | 5.  tally counter | 6.  stopwatch |
|  | | |
| 7.  colour pencils (self-provided) | | |

## STAGE 2       DATA COLLECTION

**Field Site: _____**

The straight line distance from the city centre of Central: _____m

*(refer to Map 1 on P.12)*

### 1. Microclimatic elements

➢ Each group at different field sites would measure air temperature, relative humidity, wind speed and light intensity at the same time.

➢ Collect data of microclimatic elements in every _____ minutes (_____ minutes in total) (**_SIMULTANEOUSLY_** *for all groups*)

| Weather condition: | ❑ sunny | ❑ cloudy | ❑ rainy | ❑ smog | ❑ remarks:_____ |
|---|---|---|---|---|---|

| | Time | Microclimatic elements | | | |
|---|---|---|---|---|---|
| | | Air temperature (°C) | Relative humidity (%) | Wind speed (m/s) | Light intensity (Lux) |
| 1. | _____ : _____ | | | | |
| 2. | _____ : _____ | | | | |
| 3. | _____ : _____ | | | | |
| 4. | _____ : _____ | | | | |
| **Average value** | | | | | |

## 2. **Urban heating index**

Record the data. Calculate the **total score** of the field site based on the following assessment criteria, and evaluate the **urban heating index** in the field site.

| Assessment items | Data | Assessment score / description | | | |
|---|---|---|---|---|---|
| | | **Low** | **Moderate** | **High** | **Severe** |
| **Aspect ratio** (refer to the measurement method on P.7-8) | | Smaller than 1.0 | 1.0-2.0 | 2.1-4.0 | Larger than 4.0 |
| | | **(0 mark)** | **(2 marks)** | **(4 marks)** | **(6 marks)** |
| **Flow of vehicle** (no. of vehicles/ 5 minutes) | | Less than 10 vehicles | 10-30 vehicles | 31-50 vehicles | More than 50 vehicles |
| | | **(0 mark)** | **(1 marks)** | **(2 marks)** | **(3 marks)** |
| **Level of vegetation cover** | | High | Moderate | Low | Nil |
| | | **(0 mark)** | **(1 marks)** | **(2 marks)** | **(3 marks)** |

| Total assessment score | 0-3 | 4-6 | 7-9 | 10-12 |
|---|---|---|---|---|
| Level of urban heating index | Low | Moderate | High | Severe |
| Colour | | | | |

| | Total assessment score | Level of urban heating index |
|---|---|---|
| **Field Site _____** | | |

## 3. **Others**

a) Observe the dominant land cover material at the field site: __asphalt / concrete / brick / other (____)__

b) Land use

   While return, observe the changes in land use along the study route and fill in the appropriate colours on Map 2 on P.13.
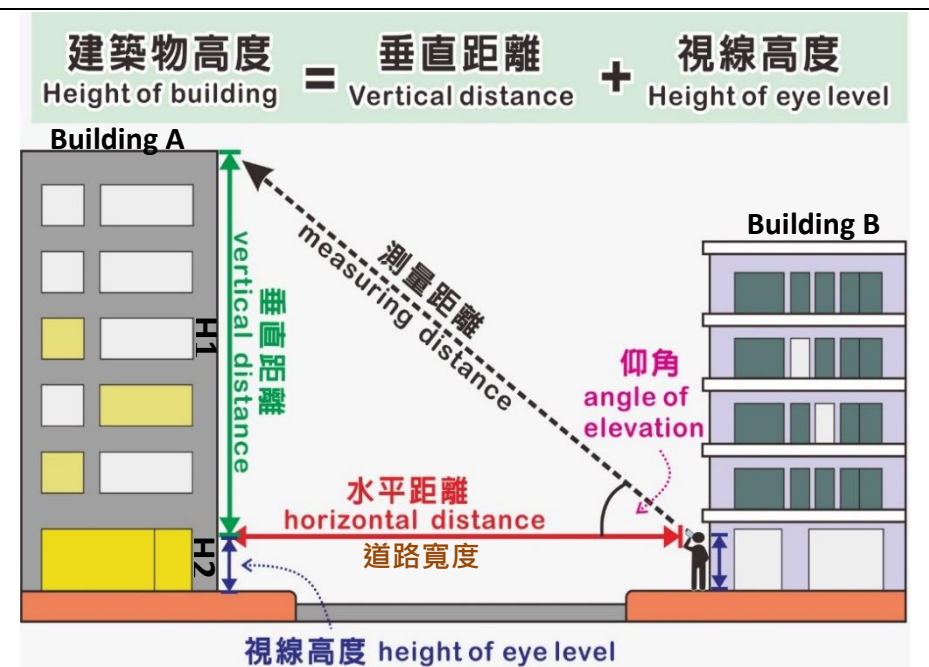
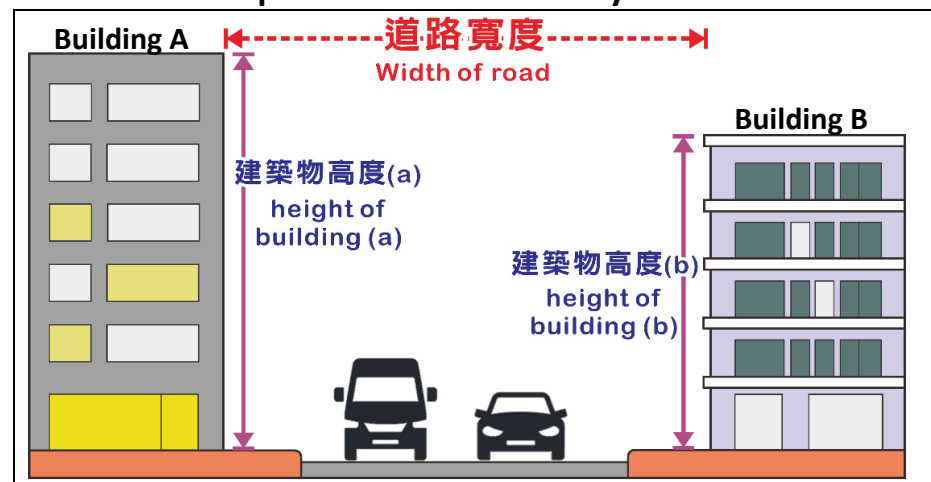| Land use | Colour |
|---|---|
| Residential | |
| Commercial | |
| Mixed (residential and commercial) | |

## Measure the width of road and the height of buildings on both sides using a laser distance meter

| Field site _____ | Aim at the top of building A | Aim at the top of building B |
|---|---|---|
| Horizontal distance measured by the equipment **(width of road)** | m | m |
| Vertical distance measured by the equipment **(H1)** | m | m |
| Height of eye level of observer* **(H2)** (*approx. body height minus 10cm) | m | m |
| Height of building **(HI + H2)** | m | m |

建築物高度 Height of building = 垂直距離 Vertical distance + 視線高度 Height of eye level

Building A

H1 垂直距離 vertical distance

測量距離 measuring distance

仰角 angle of elevation

水平距離 horizontal distance 道路寬度

H2

視線高度 height of eye level

Building B

## Calculate the aspect ratio of urban canyon

Building A

道路寬度 Width of road

建築物高度(a) height of building (a)

建築物高度(b) height of building (b)

Building B

$$\text{Aspect ratio of urban canyon} = \frac{(\text{Building height (a)} + \text{Building height (b)}) \div 2}{\text{Average road width}}$$

$$= \frac{\{(\quad\quad) + (\quad\quad)\} \div 2}{\{(\quad\quad) + (\quad\quad)\} \div 2}$$
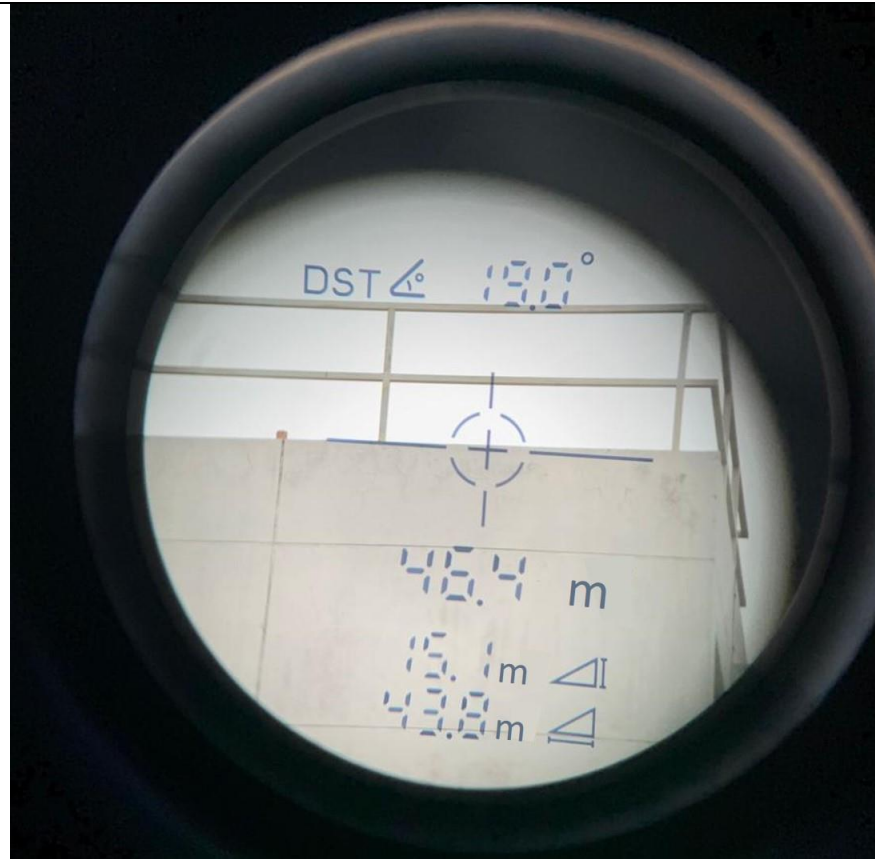
$$= \underline{\quad\quad\quad\quad}$$

(Fill in the calculated aspect ratio on P.6 )

# Use of laser distance meter

| Example: | What does the data displayed on the laser distance meter represent? |
|---|---|
| The readings displayed in the laser distance meter | Fill in the number shown in the left image in the appropriate boxes below. |
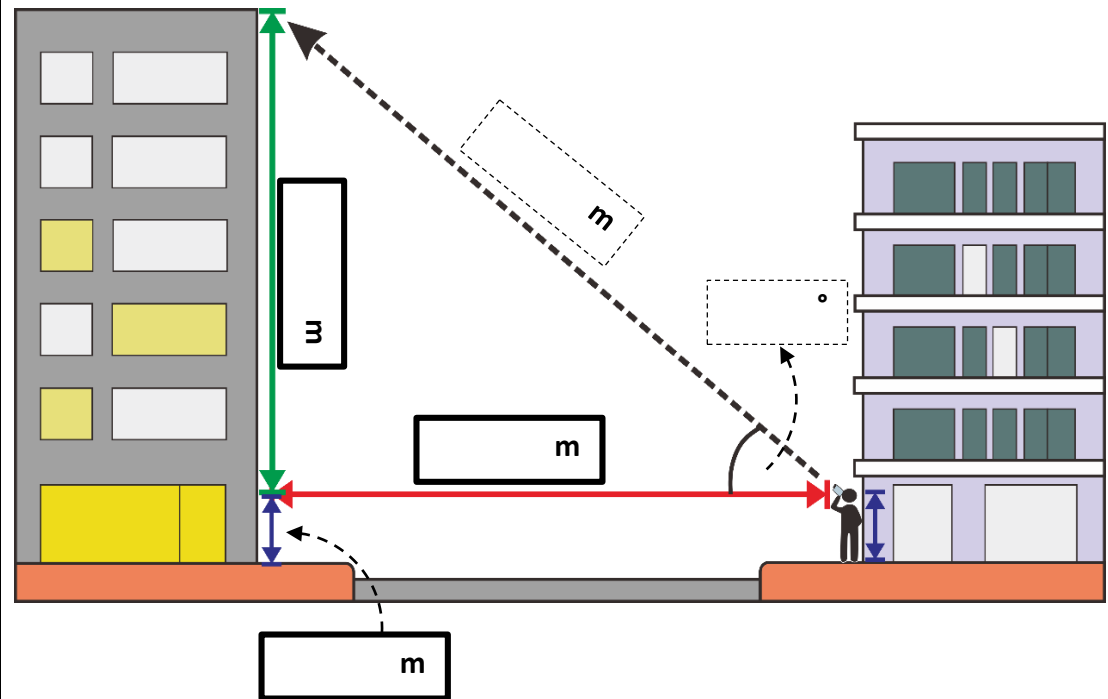




Note: [ ] Data in the thick frame are those required to calculate the aspect ratio

# STAGE 3      DATA PROCESSING & PRESENTATION

➢ **Data summary**

Summarize the data collected (P.5-6), fill in the table below.

| Field site | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Distance from city centre (m) | | | | | | | | |
| Average air temperature (℃) | | | | | | | | |
| Urban Heating Index (Total score) | | | | | | | | |

➢ **Data presentation**

| Choose suitable diagram to present the following data: | Diagram |
|---|---|
| a) Display the temperature change with the distance from city centre | |
| b) Compare the urban heating index of different field sites | |
| c) Show the spatial distribution of urban heating index (or air temperature) from Central to Mid-Levels | |
| d) Display the relationship between air temperature and distance from the city centre (or urban heating index) | |

## STAGE 4     INTERPRETATION & CONCLUSION

1. Refer to the data collected, discuss whether your hypothesis *(p.2)* is valid. Discuss the factors affecting the urban microclimate of Central.

| | Note: |
|---|---|
| | I expected that "the farther away from the city centre, the <u>higher/ lower</u> the air temperature. The result is <u>consistent/ inconsistent</u> with my hypothesis. |
| | Which location has the highest temperature? Why? Any field evidence? |
| | What do you think is the main factor affecting the microclimate in Central? |

2. How far do the data collected fit the urban climate model? Why?

| Justifications that fit | Justifications that do not fit |
|---|---|
| | Note: Are there significant differences between the locational characteristics of the field site and the urban climate model? Are these related to the fieldwork planning (such as fieldwork time or scope of study area)? |

3. *"Heat island effect is a common phenomenon in a populated city, of which the temperature in urban areas is significantly higher than that in rural areas......"*

   Select **a weather station located in the suburb** from the following webpage and compare its temperature data with that of Central. Discuss whether the statement above is true.

   Community Weather Information Network (CoWIN) https://cowin.hku.hk/chinese/series.html

   I choose to compare the data from _____ weather station with that of Central.

   Does the data reflect the influence of the urban heat island effect?   Yes / No

   Why?

4. With reference to the field evidence and choropleth map *(Map 1 on P.12)*, suggest the possible measures to tackle the problems arise from Urban Heat Island effect in Central.

# STAGE 5      EVALUATION

1. What sampling methods are used in setting the field sites? Account for the **merits** and **demerits** of these sampling methods.

2. Reflect on the planning of fieldwork. Discuss the factors that might cause data bias and propose methods to improve the **validity** and **reliability** of the data.

| Factors affecting the data reliability and validity | | Suggestion for improvement |
|---|---|---|
| **Fieldwork date/ time**<br>◆ Fieldwork date and time representative?<br>◆ Any impact by today's weather condition? | | |
| **Field site/ study area**<br>◆ Field sites match with research topic?<br>◆ Field study area adequate? | | |
| **Location of data collection (Sampling)**<br>◆ Sampling method in choosing field site appropriate?<br>◆ Location of measurement representative?<br>◆ Sample size sufficient? | | |
| **Data collection items/ methods**<br>◆ Data collection items adequate to respond the enquiry questions?<br>◆ Are the data obtained from the data collection method(s) objective and without bias?<br>◆ Any inadequacy about the equipment/ instruments?<br>◆ Measurer using the equipment/ instruments correctly? | | |

3. If we change the enquiry question from "change of urban microclimate with increasing distance from the city centre" to "influence of different land uses on urban microclimate", how will you set the measuring points of microclimate with reference to the land use distribution along the transect *(refer to Map 2 on P.13)*?

4. If the microclimatic data are collected in two different periods on the same day, how would you plan the fieldwork time to investigate the urban heat island effect in Central?

5. Further study:

   Set a study area in **the community of your school** and devise a study plan on the topic related to **the microclimate/ urban heat island effect/ wall effect** in the area *(including fieldwork date/ fieldwork time/ field sites/ sampling methods/ data collection items and methods/ equipment required, etc.)*

## Homework

After fieldwork, organize this fieldwork experience in field trip diary *(P.14-15)* as a reference for the revision of field-based question.

## Map 1

Each group collected microclimatic data and urban heating index at the following field sites.

| Group ___ | Group ___ | Group ___ | Group ___ | Group ___ | Group ___ | Group ___ | Group ___ |
|---|---|---|---|---|---|---|---|
| **Site 1** | **Site 2** | **Site3** | **Site4** | **Site 5** | **Site 6** | **Site 7** | **Site 8** |
| Dex Voeux Rd Central | Queen's Rd Central | Wellington St | Lyndhurst Terrace | Staunton St | Caine Rd | Mosque St | Conduit Rd |
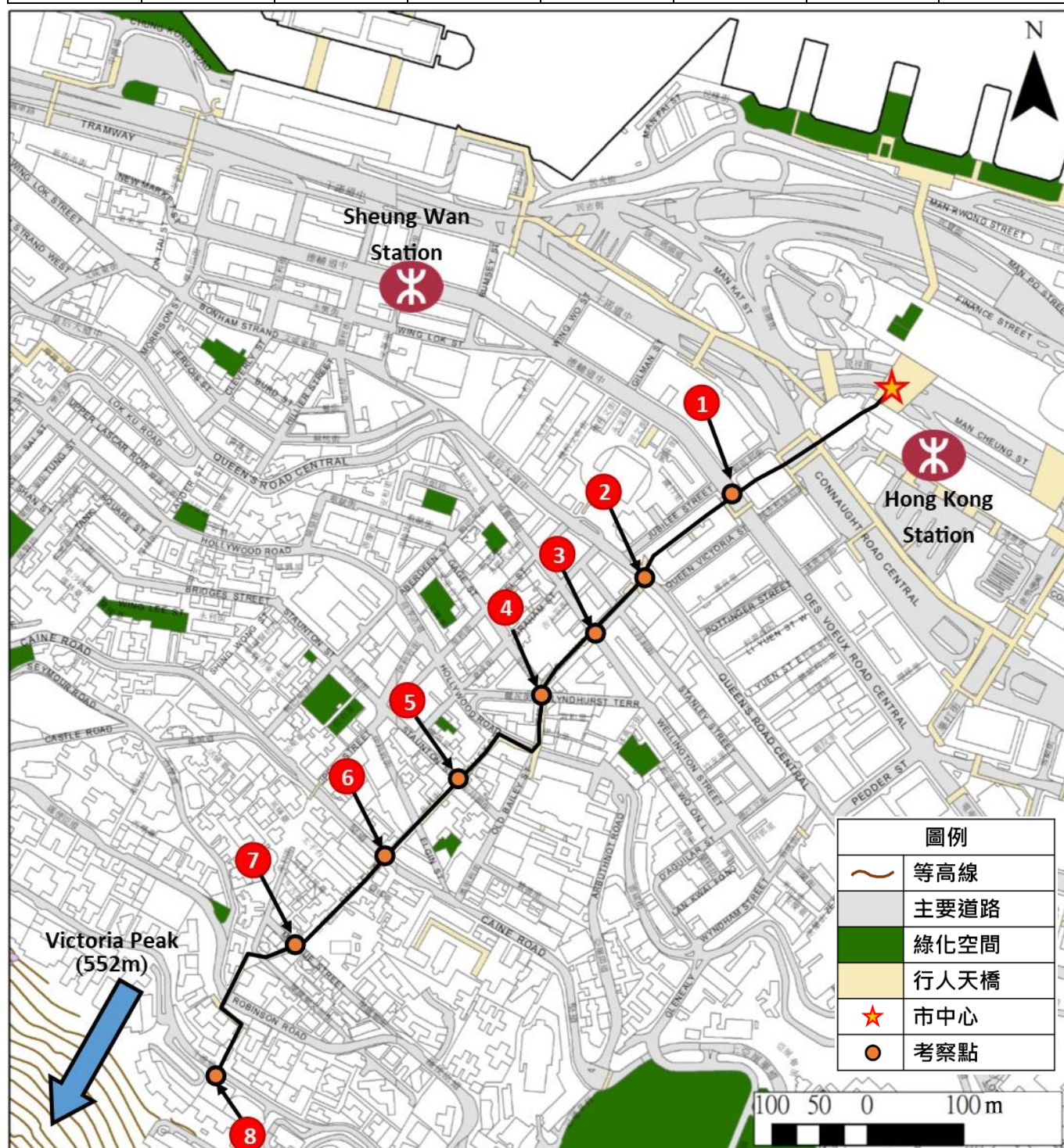


Display the spatial distribution of urban heating index in Map 1 according to the legend below *(The color classification of each group must be consistent)*.

| Total assessment score | 0-3 | 4-6 | 7-9 | 10-12 |
|---|---|---|---|---|
| **Level of urban heating index** | Low | Moderate | High | Severe |
| **Colour** | | | | |

## Map 2

While return, observe the changes in land use along the study route (Site 8 to Site 1). Fill in appropriate colours <u>within the dotted line</u>, to represent the <u>major land use</u> between field sites *(The color classification of each group must be consistent)*.

| Land use | Colour |
|---|---|
| Residential | |
| Commercial | |
| Mixed (residential and commercial) | |

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# My Field Trip Diary
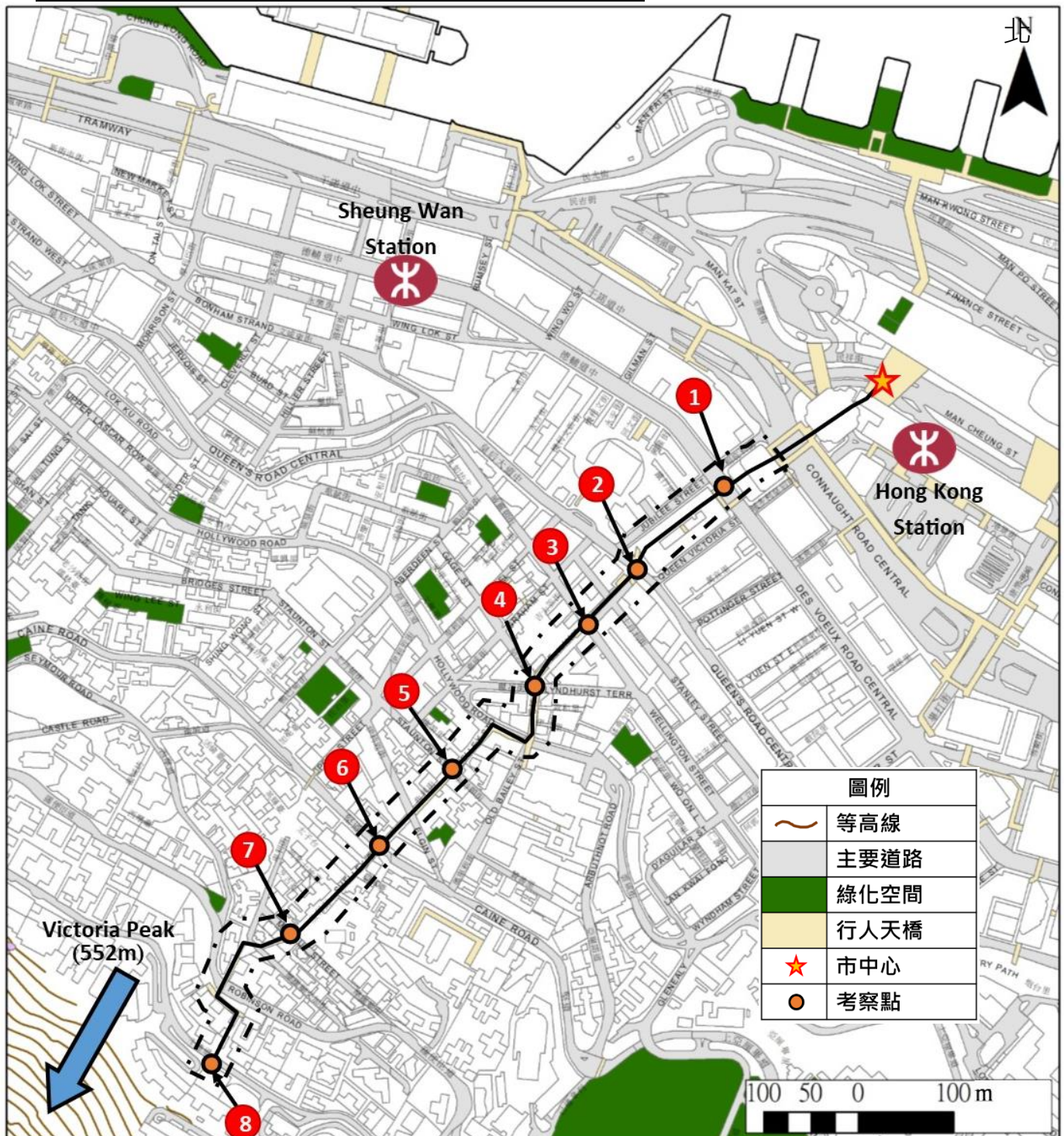
➢ Related modules: ___C7 Climate Change – Long-term fluctuation or irreversible trend?___

➢ Key point of fieldwork/topic: _____

- Date:_____ ( Weekday/ Public holiday )
- Time:_____  - Field site: _____

- Weather condition:

Is the above planning appropriate for the fieldwork?

➢ Primary data:

| Strategies of data collection | Data collected | Equipment/ Material (if any) | Merits☺/ Demerits☹ of the data collection strategy (give examples) | Suggestion for improvement (give explanations) |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

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➢ Secondary data:

| Data collected | Use | Obtained from |
|---|---|---|
|  |  |  |

| Apart from the above, what other supplementary information would be necessary to respond to the fieldwork topic? |
|---|
|  |

➢ Sampling method (if any):

| Sampling method | Applied during data collection of | Merits☺/ Demerits☹ |
|---|---|---|
|  |  |  |

➢ Data processing and presentation:

| Type of graph/ chart | Content and function of graph/chart | Merits☺/ Demerits☹ |
|---|---|---|
|  |  |  |

➢ For deeper learning or further study, I suggest modify the following aspects.

|  |  | Suggestion    (give examples) |
|---|---|---|
| ❏ | Key point of fieldwork/ topic |  |
| ❏ | Data to be collected and method of data collection |  |
| ❏ | Date and time of fieldwork |  |
| ❏ | Field site |  |

# Primary data collection methods

| Data collection methods | Explanations | | Examples |
|---|---|---|---|
| **A) Observation** | ● Using sensory observation to explore the details of research subject (people, things or environment) in a purposive and planned way. Data are recorded using text, photos, sketch, map, etc. (Refer to other data collection methods listed below) | | ● Identification of the surrounding environment of a field site |
| **B) Measurement** | ● To estimate or measure the physical quantity of the research subject. It usually requires the use of equipment or tools. Data are usually shown in certain standard, weights or measures. | | ● Measurement of the width of street and the building height |
| **C) Counting** | ● To record the number of occurrence of a single item. | | ● Statistics of pedestrian flow at the pier |
| **D) Category** | ● To classify based on the nature, characteristics and uses:<br>  ◆ to group the same or similar things;<br>  ◆ to separate different things. | | ● Types of goods sold in supermarket<br>● Customers (serving local residents and tourists) of different shops |
| **E) Distribution (mapping)** | ● To group similar things according to the research topic (similar to "**D. Category**");<br>● Only suitable for spatial representation (different from category);<br>● Useful in showing the mode of occurrence of research subject in a complex environment. | | ● Distribution of shops selling big fish balls in Cheung Chau |
| **F) Scoring** | ● To quantify abstract or subjective concepts;<br>● To merge various data for easy comparison;<br>● Scoring items should include different aspects. | | ● Risk index of natural hazards of Cheung Chau<br>● Air Quality Health Index (AQHI) |
| **G) Field sketching** | ● To make simplified drawing of the field site to show what the data collectors observed. Annotations related to the research subject are added to provide key feature or additional information. | | ● Draw the characteristics and formation of weathering landforms |
| **H) Questionnaire** | ● Forms: face-to-face, telephone, written, etc.;<br>● Using questionnaire to understand the opinion of research subject;<br>● Larger sample size than "**I. in-depth interview**";<br>● Mainly closed questions (with options available). | ● To collect information by questioning;<br>● To obtain information which is difficult to be obtained through observations;<br>● To understand the rationales and opinions of interviewees. | ● The main reasons for tourists to visit Cheung Chau<br>● The level of satisfaction among residents regarding a revitalization project |
| **I) In-depth Interview** | ● To obtain information through face-to-face/ telephone interview;<br>● Smaller sample size than "**H.Questionnaire**";<br>● Mainly open questions and forthcoming questions will change upon the answer of respondents. | | ● Opinions of District Council members on the future development of that district |

## Sampling Methods

| | Probabilistic sampling methods | | | Non-probabilistic sampling methods | | |
|---|---|---|---|---|---|---|
| | ➢ Need to know the size of population; <br> ➢ Few differences among individuals; <br> ➢ Individual has equal chance of being selected; <br> ➢ Representativeness of data depends on sampling percentage. | | | ➢ Size of population might not be relevant to the research objective; <br> ➢ Chance of individual being selected is unknown; <br> ➢ Representativeness of the results depends on the judgment of researcher in sample selection (Such as the correlation between samples and research targets). | | |
| **Sampling methods** | **Simple random sampling** <br><br> (簡單隨機抽樣) | **Systematic sampling** <br><br> (系統抽樣) | **Stratified sampling** <br><br> (分層抽樣) | **Quota sampling** <br><br> (配額抽樣/ 定額抽樣) | **Convenience sampling** <br><br> (便利抽樣/ 方便抽樣) | **Purposive sampling** <br><br> (立意抽樣) |
| **Explanations** | To select sample from the **whole population randomly**. (using computer program, bamboo slip or random number table) | Each member of the whole population is sequentially numbered, then selected according to a **fixed, periodic interval**. | The whole population are classified according to the variable and divided into separate stratum. Then samples are selected randomly by proportion from each stratum. | The whole population are classified according to the variable and divided into separate stratum. Then desired number (quota) of samples are selected from each stratum. | Research subjects are selected due to convenience of recruitment. | Samples are selected according to research objectives and special requirements. |
| **Examples** | To choose a certain number of students to conduct questionnaires/ surveys according to the class number. | To measure the noise level of a street in a regular interval. | To group buildings according to their ages (e.g. above or below 50), and select a certain number of buildings in each group randomly. | To select a certain number of male and female customers, then record the amount spent in a shop. | To interview a certain number of relatives who work in mainland China. To interview a certain number of passersby on the street | To conduct an in-depth interview with a district councilor about the social problems of that district. |
| **Remarks** | Suitable for small population and few variations among samples (for relevant research objectives). | Suitable for large population (hidden cyclic ordering which may affect the representativeness of data). | Effectively show the relationship / effect between variables. | Effectively show the relationship / effect of variables, but the characteristics and size of samples are judged subjectively. | Should not generalize the data to larger population | Suitable for qualitative research (data is easily influenced by the subjective judgment of researcher) |