Course Companion

# International Baccalaureate · IB Diploma · Geography · HL

Every topic handout in one volume

全部专题讲义合集

exercises.lol

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# Changing population (core: population distribution - changing population)

International Baccalaureate · IB Diploma · Geography · HL

## Changing population

IB Diploma Programme Geography HL (first assessment 2019; 2017 guide). This topic covers the first unit of the **core** 核心部分, *Changing population*, which SL and HL students both study. It has three parts: where people live and why, how populations change, and the challenges and opportunities this brings. Paper 2 tests the core with structured questions, a visual source and an essay. The examiners like calculations from data, so each section below shows one.

In 2024, 9.54 million babies were born in China and 10.93 million people died. The population fell for the third year in a row, to 1.408 billion. Fifty years earlier, China's problem was the opposite: too many births. In one lifetime the country has moved from fast growth to decline. This topic gives you the tools to explain such a change and to judge what governments can do about it.

**Must-know for this topic**:

| Part | Key content |
|---|---|
| distribution | physical and human factors; density; megacities; core and periphery |
| measures | birth and death rates; natural increase; doubling time; fertility |
| change | the demographic transition model; population pyramids; dependency ratio |
| policy | ageing and youthful populations; pro- and anti-natalist policies |
| migration | push and pull factors; refugees; internal migration; impacts |

## Where people live

**Population distribution** 人口分布 is the pattern of where people live. It depends on **physical factors** 自然因素 (climate, water, relief and soil) and **human factors** 人文因素 (jobs, transport, history and government policy). In China, about 94% of people live east of the "Hu Line", a line drawn from Heihe in the north-east to Tengchong in the south-west, on about 43% of the land. The west is high, dry and cold.

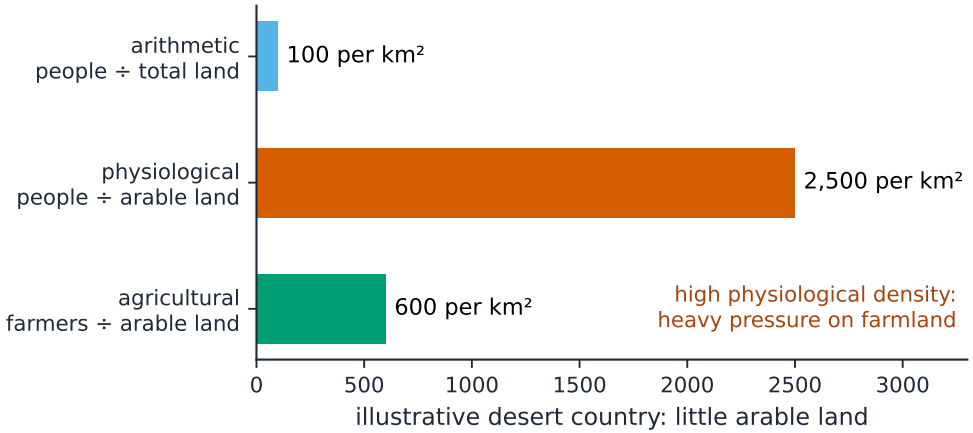



*Shibuya Crossing, Tokyo: a photograph shows crowding at one moment, but population density is people per square kilometre*

**Population density** 人口密度 is people per square kilometre:

$$\text{density} = \frac{\text{population}}{\text{area}}$$

Dividing by farmland instead of total area gives the **physiological density** 生理密度, which shows the pressure on the land that grows food.




*The same population gives very different densities depending on which land you divide by*

People also move towards cities. A **megacity** 超大城市 has more than 10 million people; there were 33 in 2018 (UN), including Shanghai, Beijing, Chongqing and Guangzhou. Inside a country, a rich, well-connected **core region** 核心区 (such as the Yangtze River Delta) attracts people, money and ideas from a poorer **periphery** 边缘区.

## Measuring population change

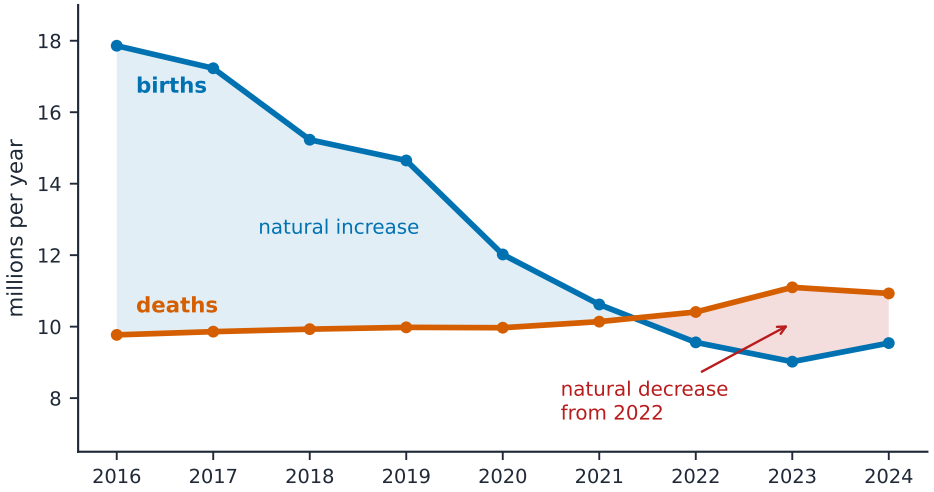
| Measure | Meaning |
|---|---|
| **crude birth rate** 粗出生率 (CBR) | live births per 1,000 people per year |
| **crude death rate** 粗死亡率 (CDR) | deaths per 1,000 people per year |
| **natural increase** 自然增长 | CBR minus CDR |
| **total fertility rate** 总和生育率 (TFR) | the average number of children a woman has |

A TFR of about 2.1 is the **replacement level** 更替水平: each generation just replaces itself. China's TFR is about 1.0; Niger's is about 6.

> **Worked example.** A country has a CBR of 24 and a CDR of 8 per 1,000.

- Natural increase $= 24 - 8 = 16$ per 1,000 $= 1.6\%$ a year.
- **Doubling time** 倍增时间 $\approx 70 \div$ growth rate in $\% = 70 \div 1.6 \approx 44$ years.

Total change also includes **net migration** 净迁移: people arriving minus people leaving.




*China's births and deaths, 2016–2024: natural decrease began in 2022*

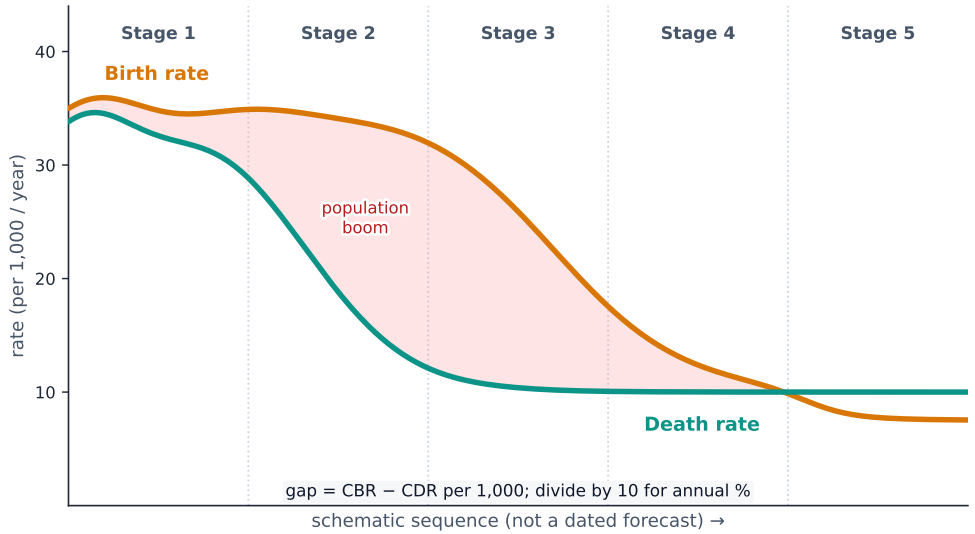
From the graph: in 2024, natural change in China was $9.54 - 10.93 = -1.39$ million.

## How populations change

### The demographic transition model

The **demographic transition model** 人口转变模型 (DTM) shows how birth and death rates change as a country develops:

| Stage | Birth rate | Death rate | Growth | Reason |
|---|---|---|---|---|
| 1 | high | high | slow | disease, little medicine |
| 2 | high | falling fast | very fast | clean water, vaccines, more food |
| 3 | falling | low | slowing | education for women, cities, contraception |
| 4 | low | low | very slow | children cost a lot; people choose small families |
| 5 | very low | low or rising | falling | an ageing population (Japan, China) |

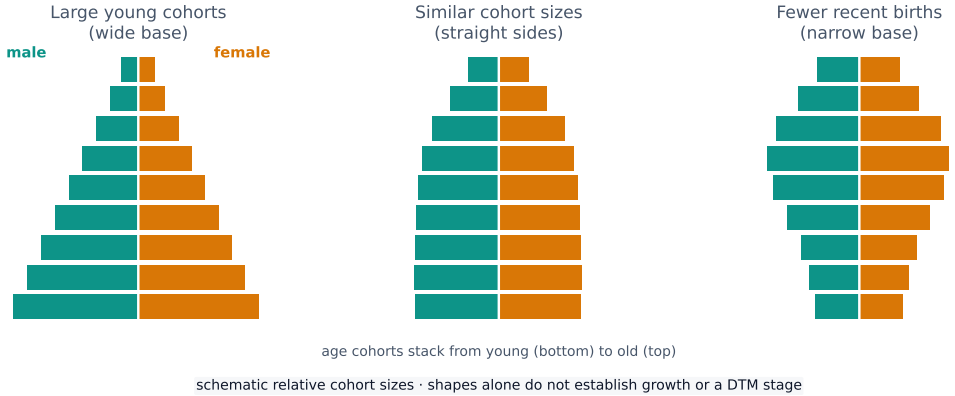



*Demographic transition: death rates fall before birth rates, and the gap is population growth*

The model is based on European history. It does not include migration, and it does not say how long each stage lasts: China passed through stages 2 to 4 in about 50 years, much faster than Britain.

### Population pyramids and dependency

A **population pyramid** 人口金字塔 shows the number of males and females in each age group. A wide base means many young people; straight sides mean similar numbers at each age; a narrow base means few recent births.




*A wide base means large young cohorts; straight sides mean similar cohort sizes*

The **dependency ratio** 抚养比 compares people of non-working age with people of working age:

$$\text{dependency ratio} = \frac{\text{aged 0–14} + \text{aged 65 and over}}{\text{aged 15–64}} \times 100$$

> **Worked example.** A town has 20,000 people aged 0–14, 15,000 aged 65 and over, and 70,000 aged 15–64. Dependency ratio = (20,000 + 15,000) ÷ 70,000 × 100 = 50. Every 100 people of working age support 50 dependants.

When birth rates fall, a country for some years has many people of working age and few dependants. This can speed up growth: the **demographic dividend** 人口红利. China's fast growth from the 1980s used this dividend; it is now ending.

## Challenges and policies

**Ageing populations** 人口老龄化 have more older people: Japan had about 29% of its people aged 65 and over in 2023. Problems: fewer workers, more spending on pensions and health care. Opportunities: older people care for grandchildren and volunteer, and "silver" industries grow. **Youthful populations** 年轻型人口 need schools and jobs; without jobs, young people may migrate or become frustrated.

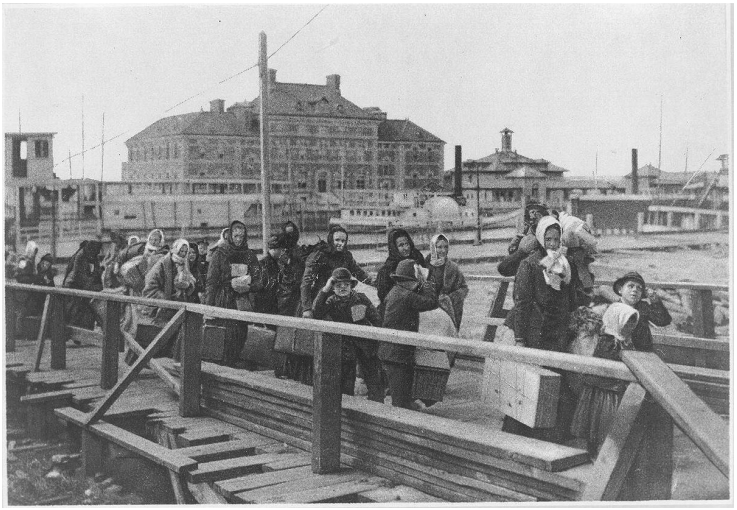
Governments respond with policies:

| Policy | Aim | Example |
|---|---|---|
| **anti-natalist policy** 限制生育政策 | fewer births | China's one-child policy, 1980–2015 |
| **pro-natalist policy** 鼓励生育政策 | more births | China's two-child (2016) and three-child (2021) policies; France's family payments |
| ageing policy | support an older population | China began slowly raising the retirement age in 2025 |

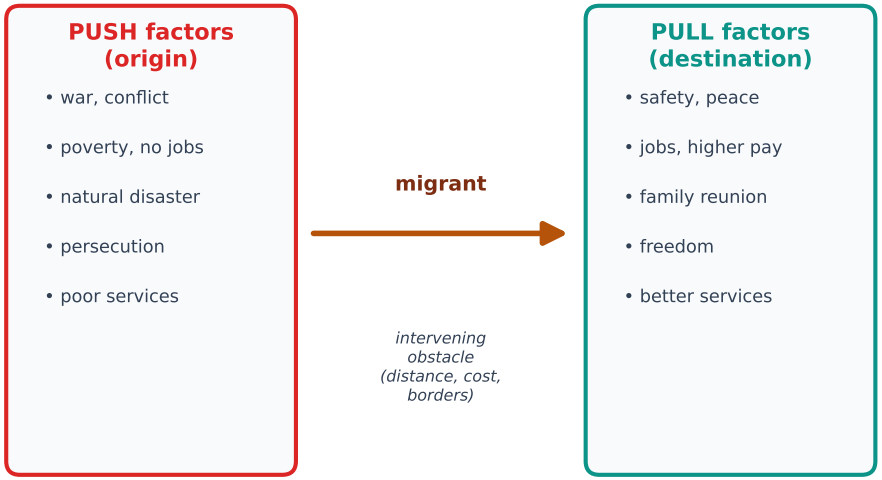
Policies on births work slowly. China allowed three children in 2021, but births kept falling, because housing, education and childcare are expensive and many young people marry later. China's **sex ratio at birth** 出生性别比 was also unbalanced: about 111 boys per 100 girls in the 2020 census, against a natural level of about 105.

## Migration

**Migration** 迁移 is a long-term move from one place to another. It can be **internal** 国内的 or **international** 国际的, and voluntary or forced.



*Migrants landing at Ellis Island, New York, c. 1900: economic pull factors drew millions across the Atlantic*




*Push factors at the origin, pull factors at the destination, and intervening obstacles between*

**Push factors** 推力因素 drive people away; **pull factors** 拉力因素 attract them; **intervening obstacles** 中间障碍 such as cost, distance and borders stop some people. There were about 280 million international migrants in 2020 (UN). A **refugee** 难民 has crossed a border to escape persecution or war; an **internally displaced person** 国内流离失所者 (IDP) has fled but stayed inside their own country.

China has one of the largest internal migrations in history: the 2020 census counted about 376 million people living outside the area where their household is registered, most of them from villages to cities in the east. Under the **hukou** 户口 system, many migrants could not easily use schools and health care in their new city, which is slowly changing.

Migration has effects on both places:

| | Place of origin | Destination |
|---|---|---|
| benefits | **remittances** 侨汇 (money sent home); less unemployment | workers for factories and services; younger population |
| problems | loss of young workers; children left with grandparents | pressure on housing and services; tension with local people |

## Checklist

- Distribution: physical and human factors; the Hu Line; arithmetic and physiological density; megacities; core and periphery.

- Measures: CBR, CDR, natural increase, TFR and replacement level 2.1; doubling time ($70 \div 1.6 \approx 44$ years); China's $-1.39$ million in 2024.
- The DTM: five stages with reasons, and two limits.
- Pyramids; the dependency ratio (worked example 50); the demographic dividend.
- Ageing and youthful populations; anti- and pro-natalist policies; the sex ratio at birth.
- Migration: push, pull and obstacles; refugees and IDPs; China's 376 million internal migrants and hukou; effects at origin and destination.



# Climate and resources (core: global climate; global resource consumption and security)

International Baccalaureate · IB Diploma · Geography · HL

## Climate and resources

IB Diploma Programme Geography HL (first assessment 2019; 2017 guide). This topic covers the second and third units of the **core** 核心部分, which SL and HL students both study: *Global climate – vulnerability and resilience* and *Global resource consumption and security*. Paper 2 tests the core. It asks short structured questions on each unit, a question on a visual source such as an infographic, and one essay. Good answers name real places at a stated **scale** 尺度 (local, national or global) and give numbers.

In July 2021, a storm dropped 201.9 mm of rain on Zhengzhou in one hour, the highest hourly total ever recorded in mainland China. Streets and a subway line flooded, and almost 400 people died across Henan. One storm cannot prove climate change, but warmer air holds more water, so very heavy rain is becoming more common. This topic asks three questions: what is changing the climate, who is hurt most, and what can people do?

**Must-know for this topic**:

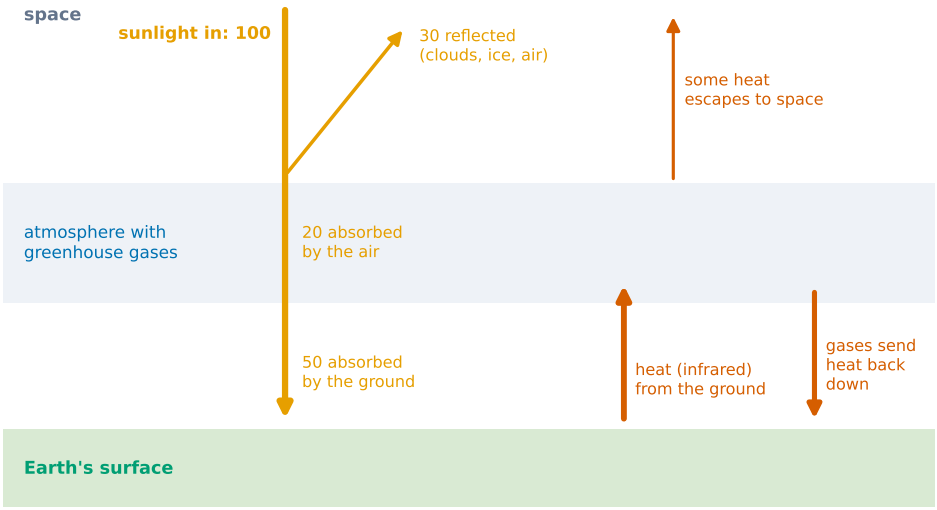
| Unit | Key content |
|---|---|
| causes | the energy balance; the greenhouse effect; natural causes; feedback loops |
| consequences | warmer air and oceans, sea level, extreme weather; who is most vulnerable |
| responses | mitigation and adaptation; agreements, carbon trading, civil society |
| consumption | population and the middle class; the ecological footprint |
| security | water, food and energy security; the water–food–energy nexus |
| stewardship | Malthus and Boserup; the SDGs; the circular economy |

## Why the climate is changing

### The energy balance and the greenhouse effect

The Earth gets energy from the Sun and loses energy as heat. If the two are equal, the average temperature stays the same. This is the **energy balance** 能量平衡. About 30% of the sunlight is reflected back to space by clouds, ice and the air. The rest warms the air and the ground. The warm ground gives off heat (infrared). **Greenhouse**

**gases** 温室气体, such as carbon dioxide ($CO_2$), methane and water vapour, absorb much of this heat and send part of it back down. This is the **greenhouse effect** 温室效应. Without it, the Earth's average temperature would be about −18 °C instead of about 15 °C.

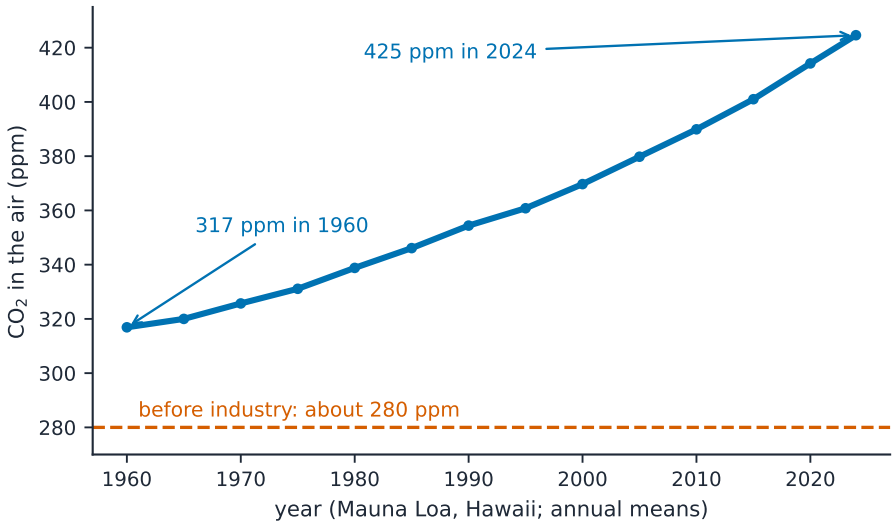



*The energy balance: greenhouse gases keep part of the Earth's heat near the surface*

People add greenhouse gases by burning coal, oil and gas, by cutting forests and from farming (cattle and rice fields release methane). This makes the greenhouse effect stronger: the **enhanced greenhouse effect** 增强的温室效应.

## The evidence

The $CO_2$ level in the air has been measured at Mauna Loa in Hawaii since 1958. Air bubbles in old ice show that for 800,000 years before industry, $CO_2$ stayed between about 180 and 300 parts per million (ppm).




*$CO_2$ at Mauna Loa: from 317 ppm in 1960 to 425 ppm in 2024*

**Worked example.** *Calculate the percentage increase in $CO_2$ from 1960 to 2024.*

$$\frac{425 - 317}{317} \times 100 \approx 34\%$$

The increase from the pre-industrial level is larger: $(425 - 280) \div 280 \times 100 \approx 52\%$.

The world was about 1.1 °C warmer in 2011–2020 than in 1850–1900 (IPCC), and 2024 was the first calendar year more than 1.5 °C above that level. Global sea level rose by about 20 cm from 1901 to 2018, because water expands as it warms and because glaciers and ice sheets melt.

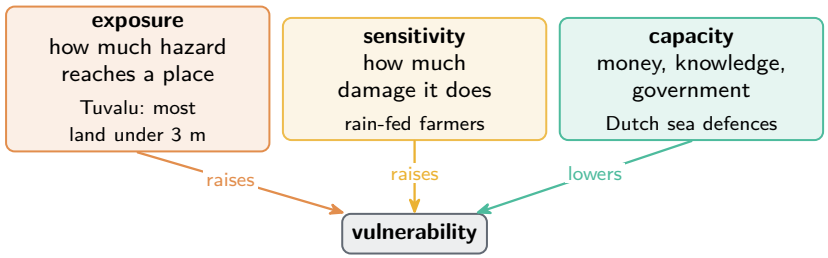
## Natural causes and feedback loops

The climate also changes for **natural causes** 自然原因: small changes in the Earth's orbit over tens of thousands of years (Milankovitch cycles), changes in the Sun's output, and large volcanic eruptions, which cool the Earth for a year or two. These cannot explain the fast warming since 1950.

A **feedback loop** 反馈回路 makes a change bigger or smaller. In a **positive feedback** 正反馈, warming melts ice; dark sea and land absorb more sunlight than white ice, so warming increases. Thawing **permafrost** 永久冻土 releases methane, which adds more warming. Such loops may push parts of the climate past a **tipping point** 临界点, after which the change cannot easily be reversed.

## Consequences and vulnerability

Climate change affects the whole Earth system: hotter heatwaves, heavier rain, longer droughts, warmer and more acidic oceans, coral bleaching, and rising seas. It affects people through health (heat stress, the spread of diseases such as dengue), food (lower yields in hot regions) and **migration** 迁移, when people leave land that floods or dries.




*Three factors decide who is hurt most.*

Not everyone is affected equally. **Vulnerability** 脆弱性 depends on three things:

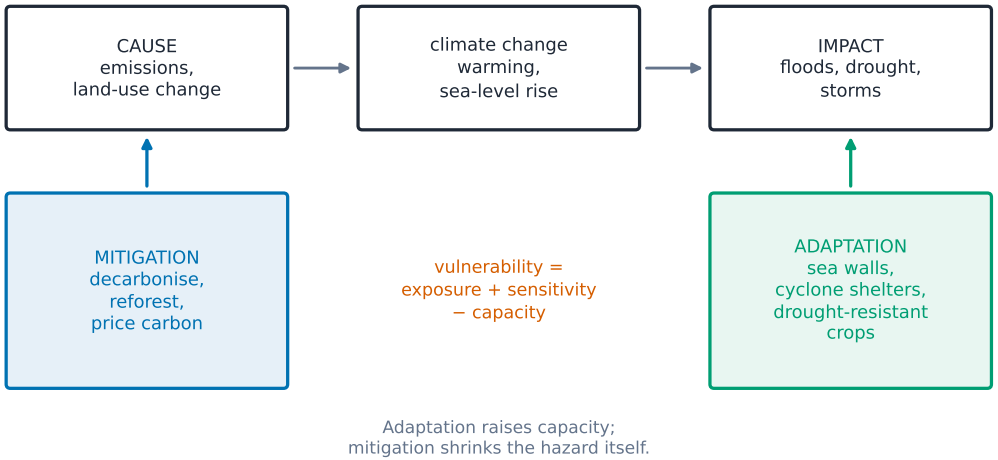
| Factor | Meaning | Example |
|---|---|---|
| exposure | how much of the hazard reaches a place | Tuvalu's land is mostly less than 3 m above sea level |
| sensitivity | how much damage the hazard does | farmers who depend on rain, not irrigation |
| capacity | the money, knowledge and government to respond | the Netherlands can afford strong sea defences |

**Resilience** 恢复力 is the ability to cope and recover. In 1970 the Bhola cyclone killed about 300,000 to 500,000 people in what is now Bangladesh. Since then Bangladesh has built thousands of cyclone shelters, trained volunteers and set up warnings by radio and phone. When Cyclone Amphan hit in 2020, a few dozen people died in Bangladesh. The hazard was similar; the capacity was very different.

## Responding to climate change

There are two kinds of response:

- **Mitigation** 减缓 reduces the cause: fewer greenhouse gases, or more carbon taken out of the air. Examples: solar and wind power, electric vehicles, planting forests, **carbon capture and storage** 碳捕集与封存.
- **Adaptation** 适应 reduces the damage: living with the change. Examples: sea walls, heat-resistant crops, "sponge cities" that soak up rain, early-warning systems, moving people away from danger.




*Mitigation acts on the cause; adaptation reduces the damage from the impact.*

Responses happen at every scale:

| Scale | Example | Judgement |
|---|---|---|
| global | **Paris Agreement** 巴黎协定 (2015): keep warming well below 2 °C and try for 1.5 °C | nearly every country joined, but pledges are voluntary and not enough |
| national | China: $CO_2$ emissions to peak before 2030 and carbon neutrality before 2060; a national **carbon trading** 碳交易 scheme since 2021 | large effect because China emits about a third of the world's $CO_2$ |
| city | sponge city pilots in 30 cities from 2015, including Wuhan | helps with floods, but the 2021 Zhengzhou rain was far beyond the design |
| civil society | Fridays for Future school strikes from 2018 | raised attention; hard to measure its effect on emissions |

Some scientists also discuss **geoengineering** 地球工程, for example spraying particles into the upper air to reflect sunlight. It might cool the Earth fast, but it does not stop $CO_2$ making oceans more acidic, and it could change rainfall in other countries.

> **Worked example.** *Evaluate one mitigation strategy.* Use four moves: name the strategy and its scale, say how it reduces the cause, measure it with a number, then give a limit. For the Paris Agreement: global; countries pledge to cut emissions and review the pledges every five years; the target is well below 2 °C; but the pledges are voluntary and, even if all are met, warming is still expected to pass 2 °C.

## Resource consumption

The world population passed 8 billion in November 2022. Consumption grows faster than population, because more people join the **middle class** 中产阶级 and buy more meat, cars and electronics.

The **ecological footprint** 生态足迹 is the area of land and sea needed to supply what a person uses and absorb their waste, in global hectares (gha). The world average is about 2.6 gha per person, but the Earth can supply only about 1.6 gha per person. So humanity uses about $2.6 \div 1.6 \approx 1.6$ to 1.7 Earths. In 2024 "Earth Overshoot Day", the day by which we had used a year's supply of nature, was 1 August.

**Renewable resources** 可再生资源 such as fish, forests, wind and sunlight can be used again if we use them no faster than they renew. **Non-renewable resources** 不可再生资源 such as coal, oil and metals exist in a fixed amount.

## Water, food and energy security

A country has **water security** 水安全 when people have enough safe water at a fair price. Farming takes about 70% of the fresh water that people withdraw. Water insecurity can be **physical** (too little water, as in the Middle East) or **economic** (water exists but people cannot afford the pipes and pumps, as in parts of sub-Saharan Africa).

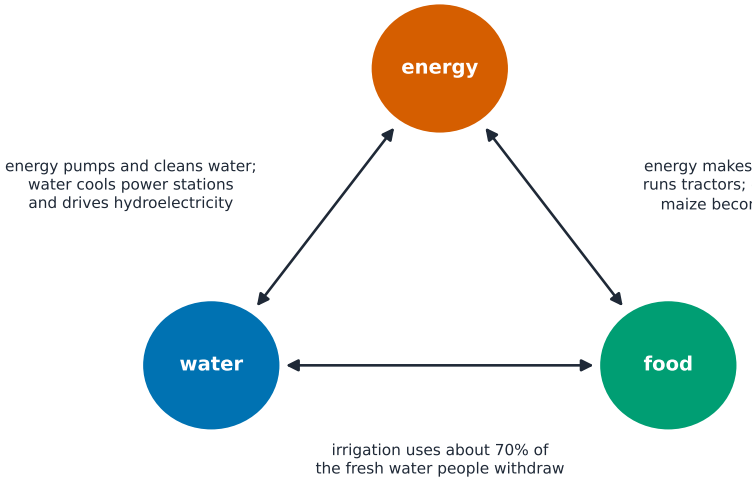


*Solar panels: renewable energy can improve energy security, if storage and cost keep supply reliable*

**Food security** 粮食安全 has four pillars: **availability** (enough food is produced or imported), **access** (people can afford it and reach it), **utilisation** (the food is safe and nutritious) and **stability** (all three last through bad years). A famine can happen even when there is enough food in a country, if poor people cannot afford it.

**Energy security** 能源安全 means a reliable supply of energy at an affordable price. China imports about 70% of the crude oil it uses, much of it by sea, which is one reason it invests heavily in solar, wind, nuclear power and electric cars.

The three resources depend on each other: the **water–food–energy nexus** 水-粮食-能源关联.



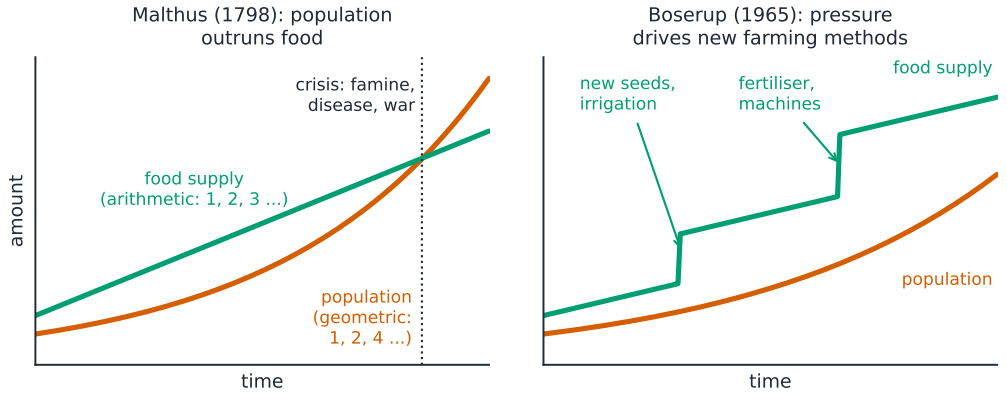

*The water–food–energy nexus: using more of one resource changes the others*

For example, growing maize for biofuel saves oil but uses farmland and water that could grow food.

## Resource stewardship

Will the Earth run out of resources? Two classic views disagree:

- Thomas Malthus (1798): population grows faster than food, so famine, disease and war will stop growth.
- Ester Boserup (1965): when population grows, people find new ways to grow more food: "necessity is the mother of invention".




*Malthus and Boserup: two views of population and resources*

So far Boserup has been closer to the truth: the **Green Revolution** 绿色革命 of the 1960s and 1970s, with new seeds, fertiliser and irrigation, raised world grain production much faster than population. But it used a lot of water and fertiliser, so a Malthusian limit may come from the environment instead of from food.

**Resource stewardship** 资源管护 means using resources carefully so that they last. The United Nations' 17 **Sustainable Development Goals** 可持续发展目标 (2015) include clean water (Goal 6), clean energy (Goal 7) and responsible consumption (Goal 12). A **circular economy** 循环经济 keeps materials in use by repairing, reusing and recycling, instead of the "take, make, throw away" of a linear economy. China passed a Circular Economy Promotion Law in 2008.

## Checklist

- The energy balance (30% reflected); the greenhouse and enhanced greenhouse effect; $CO_2$ 280 → 317 → 425 ppm and the percentage calculation; 1.1 °C warming and 20 cm sea-level rise.
- Natural causes; positive feedback loops (ice, permafrost); tipping points.
- Consequences for the Earth and for people; vulnerability as exposure, sensitivity and capacity; resilience (Bangladesh 1970 and 2020).
- Mitigation and adaptation with examples at global, national, city and civil-society scales; geoengineering.
- Population and the middle class; the ecological footprint (2.6 against 1.6 gha); renewable and non-renewable resources.
- Water, food (four pillars) and energy security; the water–food–energy nexus.
- Malthus and Boserup; the Green Revolution; the SDGs; the circular economy.



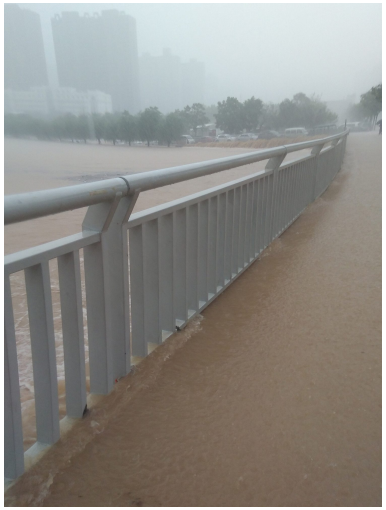
# Options and fieldwork (option themes menu; geographic inquiry and sampling)

International Baccalaureate · IB Diploma · Geography · HL

## Options and fieldwork

IB Diploma Programme Geography HL (first assessment 2019; 2017 guide). Besides the core, every student studies **optional themes** 选修主题: SL students study two of the seven options and HL students three. The options are examined in Paper 1. Every student also writes a **fieldwork** 野外考察 report on data they collect themselves: the **internal assessment** 内部评估 (IA). This topic gives each option's key ideas, processes and one case study, and then teaches the fieldwork method from question to conclusion.

In July 2021 more than 600 mm of rain fell on Zhengzhou in three days, close to the city's normal rainfall for a whole year. Water poured into underground train tunnels and roads became rivers. A few months later, coastal towns in England were still arguing about whether to build higher sea walls or let the sea take low farmland. The options study questions like these: how physical processes work, how they affect people, and how people manage them.



*Floodwater pouring over a riverside path in Zhengzhou during the rain of 20 July 2021*

**Must-know for options and fieldwork**:

| Area | Key content |
|---|---|
| Paper 1 | each option: structured questions (10 marks) and one essay from a choice of two (10 marks) |
| freshwater | drainage basin; storm hydrograph and lag time; hard and soft flood management |
| coasts | wave erosion and deposition; groynes, sea walls, managed realignment |
| extreme environments | glacial and hot-arid processes; opportunity against challenge |
| hazards | plate margins; risk depends on the hazard, exposure and vulnerability |
| tourism | Butler's model; carrying capacity; Venice's controls |
| food and health | famine as a failure of access; the epidemiological transition |
| urban | land-use models; megacities; urban stress and regeneration |
| fieldwork | question, hypothesis, sampling, analysis with $r_s$ or $\chi^2$, evaluation |

## How the options are examined

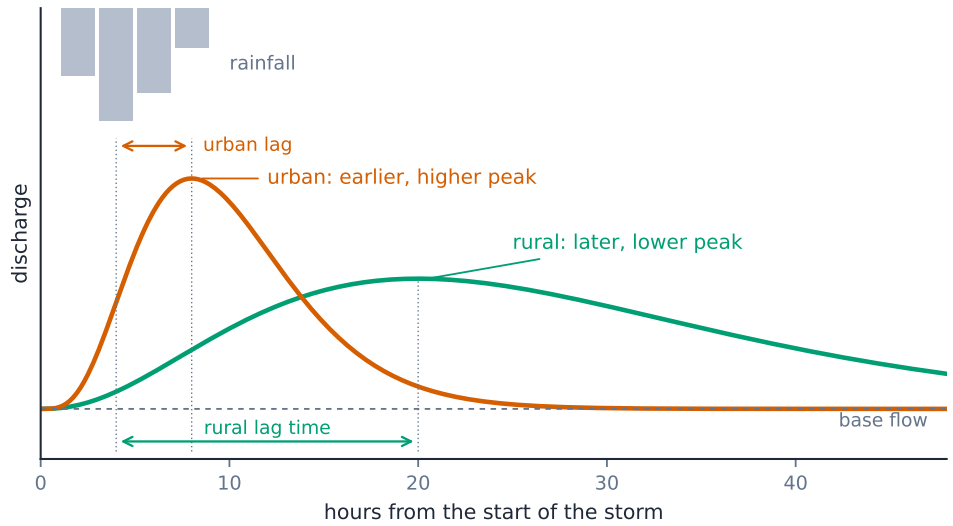
In Paper 1 each option has 20 marks. The first part is a set of short **structured questions** 结构化问题 (10 marks), often about a map, graph or table. Then you choose one of two essays (10 marks). SL students answer two options in 1 hour 30 minutes; HL students answer three in 2 hours 15 minutes.

The essays use the command terms *examine*, *discuss*, *evaluate* and *to what extent*. An essay answer needs a clear view, named examples with **specific detail** 具体细节 (places, dates, numbers), and a balanced judgement. "Floods are bad for people" earns little; "the 2021 Zhengzhou flood killed 380 people, including 14 passengers trapped in a flooded metro train" earns credit.

## Freshwater

A **drainage basin** 流域 is the area of land that a river and its tributaries drain. Rain that falls on it can be stored (in soil, lakes and groundwater) or move to the river: over the surface (**surface runoff** 地表径流) or more slowly through the soil and rock.

A **storm hydrograph** 暴雨水文曲线 shows how a river's **discharge** 流量 (the volume of water passing a point each second) changes after a storm. Discharge rises along the **rising limb** 上升段 to a **peak** 洪峰 and falls along the falling limb. The time from peak rainfall to peak discharge is the **lag time** 滞后时间.




*The same storm on two basins: the urban one peaks sooner and higher, so its lag time is shorter.*

Cities shorten the lag time and raise the peak. Concrete and roofs do not let water soak in, and drains carry it quickly to the river. Steep slopes, saturated soil and a small, round basin have the same effect; forests and gentle slopes slow water down.

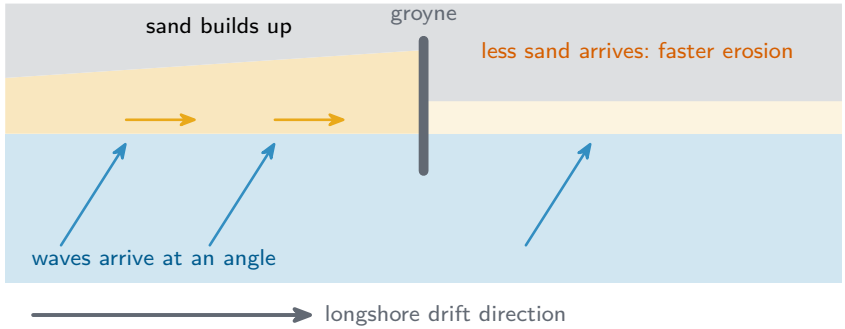
**Flood management** 洪水管理 can be hard or soft:

| Type | Examples | Strengths | Weaknesses |
|---|---|---|---|
| **hard engineering** 硬工程 | dams, embankments, straightened channels | protects a large area; can also store water and make electricity | expensive; changes the river ecosystem; can move the flood downstream |
| **soft engineering** 软工程 | planting trees, wetlands, floodplain zoning, "sponge city" parks | cheaper; works with nature; better for wildlife | slower to work; needs land; may not stop a very large flood |

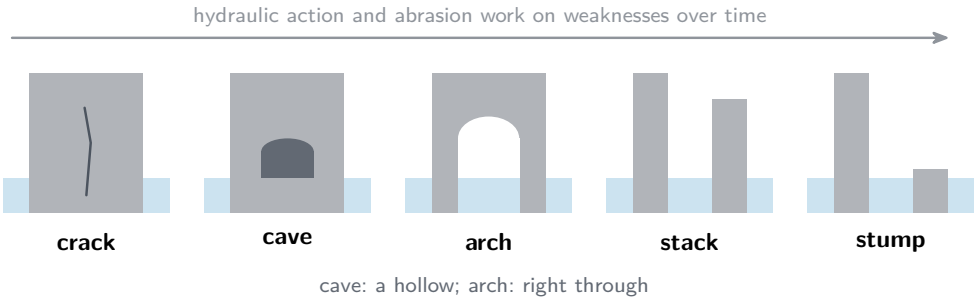
**Case study: the Three Gorges Dam.** The dam on the Yangtze (main body finished in 2006, fully working by 2012) stores flood water, generates about 22.5 GW of electricity and lets large ships reach Chongqing. About 1.3 million people were moved from the land the reservoir covered, and the dam traps sediment that once built up land downstream. China's **sponge city** 海绵城市 programme (started 2015) is a soft response for cities: parks, wetlands and porous pavements that hold rain where it falls.

## Oceans and coastal margins

Waves shape coasts. They erode rock by **hydraulic action** 水力作用 (water and air forced into cracks) and **abrasion** 磨蚀 (rocks thrown against the cliff). Where waves lose energy, they deposit sand and shingle as beaches and **spits** 沙嘴. Where hard and soft rocks meet the sea, the soft rock is eroded into bays and the hard rock is left as headlands; caves, arches and stacks form at the headlands.




*Defend one place and the next place pays.*




*Crack, cave, arch, stack, stump.*

**Longshore drift** 沿岸漂移 moves sand along the coast in the direction of the main wind and waves. This is why coastal defences in one place affect the next place.

| Strategy | How it works | Problem |
|---|---|---|
| sea wall | a concrete wall reflects waves | expensive; waves erode the beach in front of it |
| **groyne** 丁坝 | a low wall across the beach traps drifting sand | the coast further along gets less sand and erodes faster |
| **beach nourishment** 海滩补沙 | sand is added to the beach | must be repeated every few years |
| mangrove planting | roots hold mud and slow waves | needs warm, sheltered coasts and time to grow |
| **managed realignment** 有计划退让 | old defences are removed and the sea floods low land, making a salt marsh | farmland and some homes are lost |

**Case study: the Holderness coast, England.** Its soft clay cliffs lose about 2 m a year on average, one of the fastest rates in Europe. Groynes built at Mappleton in 1991 protected the village, but the cliffs to the south then eroded faster because they received less sand. At Medmerry (2013) the sea defences were moved inland, and the new salt marsh now protects homes and is a habitat for birds. A good essay weighs who gains and who loses from each choice.

## Extreme environments

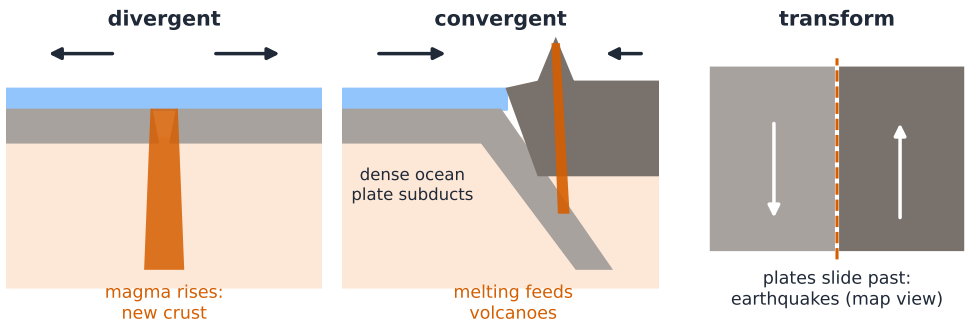
**Extreme environments** 极端环境 are cold (high mountains, polar and glacial areas) or dry (hot deserts). Ice erodes valleys into a U shape and leaves piles of rock called **moraines** 冰碛. In hot deserts, wind builds dunes and rare flash floods cut steep valleys called wadis.

People see these places as both **opportunities** 机遇 (minerals, tourism, solar energy, scientific research) and **challenges** 挑战 (cold or heat, little water, poor access, a fragile environment).

**Case study: the Qinghai-Tibet Railway** (opened 2006). Much of the line crosses **permafrost** 永久冻土, ground that stays frozen all year. Heat from a train track could melt it and make the track sink, so engineers built bridges and used pipes that carry heat out of the ground. The railway brings tourists and trade to Tibet; it also brings pressure on a fragile environment and on local culture.

## Geophysical hazards

The Earth's surface is broken into **tectonic plates** 构造板块 that move a few centimetres a year. Most volcanoes and earthquakes happen at **plate margins** 板块边缘:




*Constructive (divergent), destructive (convergent) and conservative (transform) margins.*

| Margin | Movement | Hazards | Example |
|---|---|---|---|
| **constructive margin** 建设性板块边缘 | plates move apart | gentle volcanoes, small earthquakes | Iceland |
| **destructive margin** 破坏性板块边缘 | one plate sinks under another | explosive volcanoes, large earthquakes, tsunamis | Japan |
| **conservative margin** 保守性板块边缘 | plates slide past each other | earthquakes | California |

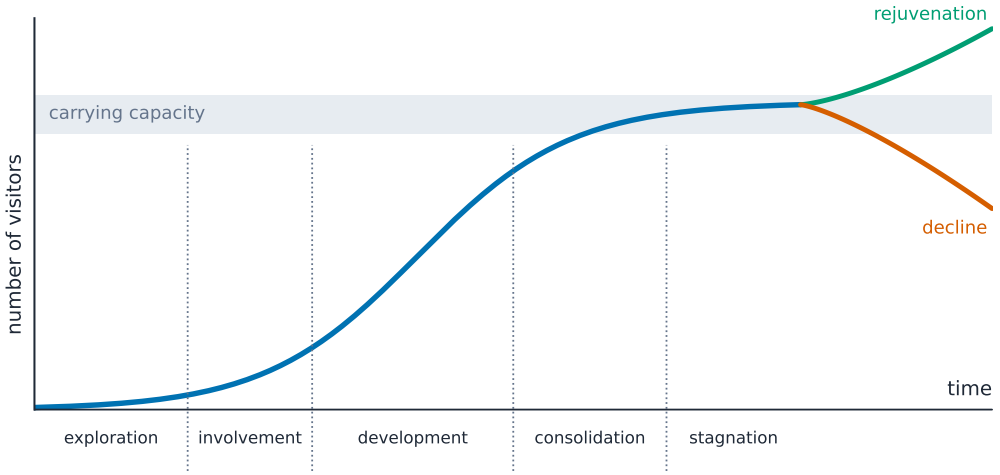
**Hazard risk** 灾害风险 grows with three things: how strong and frequent the hazard is, how many people and buildings are in its path (**exposure** 暴露度), and how easily they are harmed (**vulnerability** 脆弱性). Poverty, weak buildings and poor warning systems raise vulnerability.

$$\text{risk} = \text{hazard} \times \text{exposure} \times \text{vulnerability}$$

The model explains why similar events have very different results. The 2010 Haiti earthquake (magnitude 7.0) killed more than 100,000 people, because many buildings were weak and the capital was close to the **epicentre** 震中. The 2011 Tōhoku earthquake in Japan (magnitude 9.0) released about 1,000 times more energy. Strong buildings and early warnings saved many lives, but the tsunami was higher than many sea walls and about 18,000 people died or were never found.

## Leisure, tourism and sport

The **Butler model** 巴特勒模型 describes how a tourist destination changes over time. A few visitors explore it; local people start to provide services; companies build hotels and visitor numbers grow fast. Growth slows as the place reaches its **carrying capacity** 承载力, the number of visitors it can take before the environment or visitor experience suffers. Then it stagnates, and either declines or is rejuvenated by new investment.




*Butler's model: growth slows near the carrying capacity, then the destination is rejuvenated or declines*

**Case study: Venice.** Fewer than 50,000 people live in the historic centre, but on busy days it receives far more visitors than residents. **Overtourism** 过度旅游 raises rents, pushes residents out and crowds the streets. Venice has stopped large cruise ships from sailing through the city centre (2021), limited tour groups to 25 people (2024) and charged day visitors an entry fee on the busiest days (since 2024). Critics ask whether a fee of a few euros changes behaviour or only raises money.

## Food and health

**Food security** 粮食安全 means that all people can get enough safe and healthy food at all times. A **famine** 饥荒 often happens not because there is no food, but because people cannot afford or reach it. The economist Amartya Sen argued that in the Bengal famine of 1943 food was available, but prices rose far faster than the wages of the poor. This links to the "access" pillar of food security in topic 02.

As countries develop, the main causes of death change. This is the **epidemiological transition** 流行病学转变: deaths from infectious diseases (such as diarrhoea and tuberculosis) fall, people live longer, and **non-communicable diseases** 非传染性疾病 (heart disease, cancer, diabetes) become the main causes of death. Cheap high-calorie food and less physical work also raise **obesity** 肥胖. China has made this change within one lifetime: life expectancy rose from about 59 years in 1970 to about 79 years in 2023.

## Urban environments

More than half of the world's people live in cities. A **megacity** 特大城市 has more than 10 million people. Shenzhen grew from a small border town in 1980 to about 17.6 million people in the 2020 census.



*An informal settlement (favela) on a Rio de Janeiro hillside, built where formal housing and services could not keep up with growth*

**Land-use models** 土地利用模型 describe how a city is arranged. Burgess's model shows rings around the centre; Hoyt's model shows sectors along transport routes. Use them as ideas to test against a real city, not as truths.

Fast growth causes **urban stress** 城市压力: housing shortages, traffic congestion, air pollution and waste. Responses include public transport, new housing and **urban regeneration** 城市更新, which turns old industrial land into new homes, offices and parks. A good evaluation asks who benefits: regeneration can raise rents and push poorer residents out.

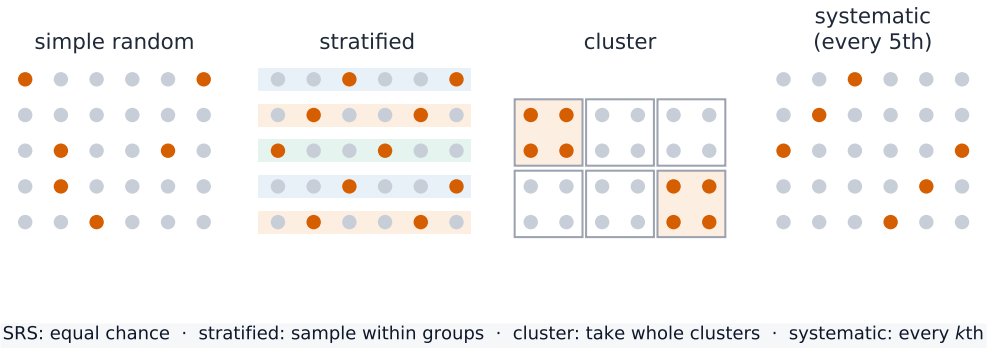
## Fieldwork: geographic inquiry and sampling

The fieldwork report is worth 25% at SL and 20% at HL. It is a report of up to 2,500 words, marked out of 25, on **primary data** 一手数据 that you collect yourself in the field.

| Stage | What you do |
|---|---|
| fieldwork question | a precise, local question you can answer with data you collect |
| **hypothesis** 假设 | a testable statement; for a statistical test, also a **null hypothesis** 零假设 of no relationship |
| method | what you measure, where and when; a risk assessment and an ethics check |
| sampling | random, systematic or stratified (below) |
| presentation | maps, graphs and tables chosen to suit the data |
| analysis | describe the pattern, then test it, for example with Spearman's rank |
| conclusion and evaluation | answer the question; name the limitations and how to improve the method |

You cannot measure everything, so you take a sample:

| Sampling | How | Strength | Weakness |
|---|---|---|---|
| **random sampling** 随机抽样 | random numbers choose each point | no bias from the student | may miss small areas |
| **systematic sampling** 系统抽样 | every 100 m along a line, or every tenth person | covers the area evenly | can match a regular pattern by chance |
| **stratified sampling** 分层抽样 | samples in proportion to known zones | every zone is represented | you must know the zones first |



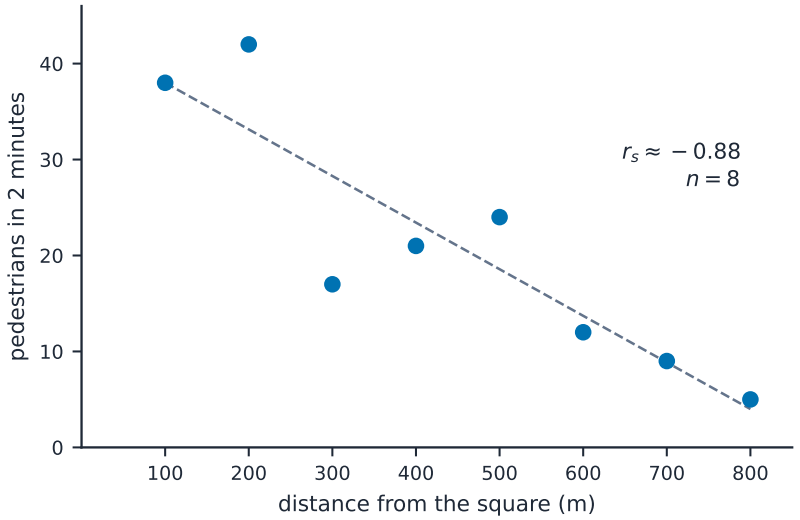

*Random, stratified and systematic samples (and cluster, for comparison) on the same grid of sites*

**Worked example.** Question: *Does the number of pedestrians fall with distance from the central square?* Hypothesis: pedestrian numbers fall as distance increases. Null hypothesis: there is no relationship. The student counted pedestrians for 2 minutes every 100 m along one street (systematic sampling).

| **Distance (m)** | **100** | **200** | **300** | **400** | **500** | **600** | **700** | **800** |
|---|---|---|---|---|---|---|---|---|
| pedestrians | 38 | 42 | 17 | 21 | 24 | 12 | 9 | 5 |
| rank of distance | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| rank of pedestrians (1 = fewest) | 7 | 8 | 4 | 5 | 6 | 3 | 2 | 1 |
| $d^2$ | 36 | 36 | 1 | 1 | 1 | 9 | 25 | 49 |

Here $d$ is the difference between the two ranks, $n = 8$ and $\sum d^2 = 158$. **Spearman's rank correlation** 斯皮尔曼等级相关 is

$$r_s = 1 - \frac{6\sum d^2}{n(n^2-1)} = 1 - \frac{6 \times 158}{8 \times 63} = 1 - \frac{948}{504} \approx -0.88$$




*The eight counts fall with distance: Spearman's $r_s \approx -0.88$*

The value is negative, so pedestrian numbers fall as distance rises. For $n = 8$, the critical value at the 5% level (two-tailed) is 0.738. Because 0.88 is bigger than 0.738, we reject the null hypothesis: the relationship is **statistically significant** 统计显著. This does not prove that distance causes the change: shops are also closer to the square.

For counts in categories, use a **chi-squared test** 卡方检验 instead. For a table with two rows and two columns there is 1 degree of freedom, and the critical value at the 5% level is 3.84; a result of 5.2 is above it, so the two variables are not independent.

**Evaluation** of the worked example: one street, one weekday morning and one 2-minute count per site. Better: several streets, counts at different times and days, and two or three counts at each site.

| **Criterion** | **Marks** |
|---|---|
| A: fieldwork question and geographic context | 3 |
| B: method(s) of investigation | 3 |
| C: quality and treatment of information collected | 5 |
| D: written analysis | 10 |
| E: conclusion | 2 |
| F: formal requirements | 2 |

## Checklist

- Paper 1: 20 marks per option (structured questions and one essay); specific detail in every essay.
- Freshwater: the storm hydrograph and lag time; why cities flood faster; hard and soft management; the Three Gorges Dam and sponge cities.
- Coasts: hydraulic action and abrasion; longshore drift; the strategies and their problems; Holderness, Mappleton and Medmerry.
- Extreme environments: glacial and desert landforms; opportunity against challenge; the Qinghai-Tibet Railway on permafrost.
- Hazards: the three plate margins; risk from hazard, exposure and vulnerability; Haiti 2010 against Tōhoku 2011.
- Tourism: Butler's stages and carrying capacity; Venice's controls.
- Food and health: famine as a failure of access; the epidemiological transition.
- Urban: megacities; Burgess and Hoyt as models to test; urban stress and regeneration.
- Fieldwork: the inquiry stages; the three sampling methods; the Spearman's rank calculation and its critical value; chi-squared; the six IA criteria.



# Global interactions (HL extension: power/places/networks; development/diversity; risks/resilience)

International Baccalaureate · IB Diploma · Geography · HL

## Global interactions

IB Diploma Programme Geography HL (first assessment 2019; 2017 guide). This topic covers the **HL extension** 高级程度拓展部分, *Geographic perspectives – global interactions*. It has three units: power, places and networks; human development and diversity; and global risks and resilience. Paper 3 (HL only, 1 hour) asks one question from a choice of three, one per unit. Each question has a part (a) worth 12 marks and an essay part (b) worth 16 marks. Good answers use examples at more than one scale and show how places are connected.

In March 2021 the container ship *Ever Given* got stuck across the Suez Canal for six days. Hundreds of ships waited at both ends, and factories in Europe ran short of parts made in Asia. One ship in one canal showed how closely the world's places are linked, and how a problem in one place can spread everywhere. That is the idea behind this whole topic.

**Must-know for this topic**:

| Unit | Key content |
|---|---|
| power, places and networks | global flows; superpowers and groups such as the G20; TNCs; core and periphery |
| human development and diversity | HDI and poverty; cultural diffusion and glocalisation; local resistance |
| global risks and resilience | pandemics, financial crises, chokepoints, pollution; resilience and cooperation |

## Power, places and networks

### Global flows

**Globalisation** 全球化 is the growing connection between places through four kinds of **flow** 流动:




*A container port: shipping networks connect places, but the flows of power and profit behind them are not visible in the photo*

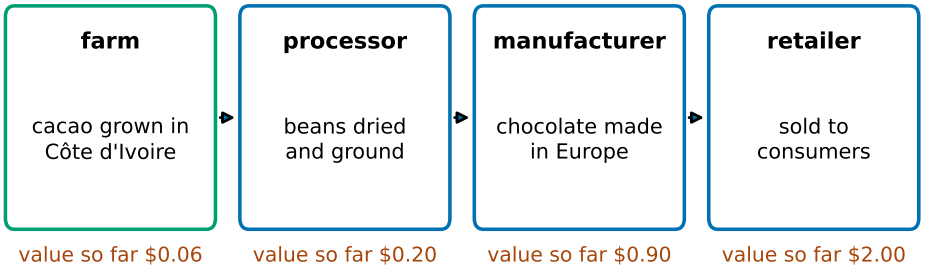
| Flow | Example | Size |
|---|---|---|
| goods and services | phones from China, software from India | exports are about 30% of world GDP |
| money | **foreign direct investment** 外国直接投资 (FDI), aid, remittances | **remittances** 侨汇 to low- and middle-income countries were about US$650 billion in 2023 |
| people | migrants, students, tourists | about 280 million international migrants (UN, 2020) |
| information | the internet, films, social media | about two thirds of people use the internet |

A **global network** 全球网络 has **nodes** 节点 (cities and ports) and **links** 连接 (shipping lanes, flight routes, undersea cables). A place with many links, such as Shanghai, Singapore or London, gains more trade, more investment and more power. A poorly connected place, such as a landlocked country with weak roads, finds it hard to join in.

### Global power

A **superpower** 超级大国 has economic, military, political and cultural power that reaches the whole world; today the United States and China are usually named. Countries also act in groups. The **G20** 二十国集团 produces about 85% of world GDP and 75% of world trade. International organisations set rules for everyone: the United Nations (193 member states), the International Monetary Fund, the World Bank and the World Trade Organization.

**Transnational corporations** 跨国公司 (TNCs) operate in many countries. They usually keep research, design and headquarters in rich countries and place factories where costs are lower; this is **outsourcing** 外包 or **offshoring** 离岸外包. More of the money is made in design, branding and selling than in growing or making the product, so the **core** 核心地区 gains more than the **periphery** 边缘地区.




*A global commodity chain: most value is added far from where the raw material is grown*

> **Worked example.** In the illustration, a bar of chocolate sells for $2.00 and the cacao farmer receives $0.06. The farmer's share is
>
> $$\frac{0.06}{2.00} \times 100 = 3\%$$

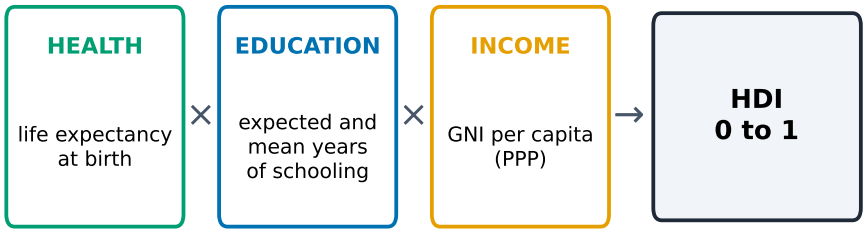
The other 97% is added by processing, manufacturing, branding and selling, mostly in core countries.

Power does not only flow one way. Chinese, Indian and Brazilian companies now invest abroad, and governments can tax and regulate TNCs or refuse them entry.

## Human development and diversity

### Measuring development

The **Human Development Index** 人类发展指数 (HDI) combines three dimensions: health, education and income. Each is scored from 0 to 1, and the HDI is a kind of average of the three. In 2022, Switzerland scored 0.967, China 0.788 and Somalia 0.380 (UNDP).




each dimension is scored 0 to 1; the HDI is the cube root of the three scores multiplied

*The HDI combines health, education and income into one index from 0 to 1*

The **Gender Inequality Index** 性别不平等指数 (GII) measures gaps between women and men in health, education, work and politics. About 700 million people still live in **extreme poverty** 极端贫困, on less than $2.15 a day (World Bank). Development is more than income: it is the freedom and ability to live the life you value.

## Changing identities and cultures

Global flows carry culture as well as goods. **Cultural diffusion** 文化扩散 spreads foods, music, brands and languages. Some people fear **cultural homogenisation** 文化同质化: every city with the same shops and films. But global brands often change to fit local tastes: **glocalisation** 全球本土化. KFC in China sells rice porridge (congee) and fried dough sticks (youtiao) for breakfast, and Shanghai Disneyland (2016) added Chinese designs and festivals. Cultures also mix to create new **hybrid** 混合 forms, such as K-pop, which mixes Korean and American music styles.

## Local responses

Not everyone welcomes **global interactions** 全球互动. Responses include:

- **Protectionism** 贸易保护主义: tariffs and quotas to protect local jobs.
- **Fairtrade** 公平贸易: a guaranteed minimum price for about 2 million farmers and workers.
- **Civil society** 公民社会 campaigns, such as protests against factory working conditions.
- Indigenous groups protecting their land, language and knowledge.

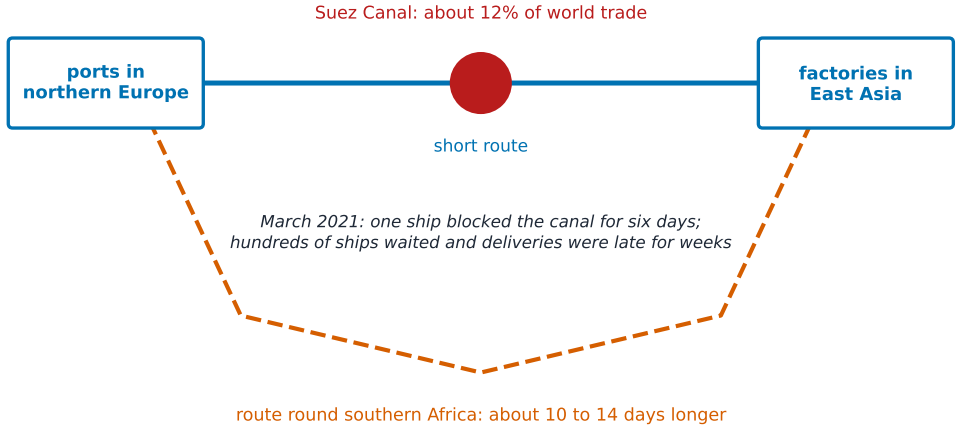


# Global risks and resilience

## Risks that cross borders

Because places are linked, problems spread quickly. **Global risks** 全球风险 include:

| Risk | Example |
|---|---|
| pandemic | COVID-19 cut world GDP by about 3% in 2020 (IMF) |
| financial crisis | the 2008 crisis began in the United States housing market and spread to banks everywhere |
| supply-chain **chokepoint** 咽喉要道 | the 2021 Suez Canal blockage |
| **transboundary pollution** 跨境污染 | smoke from forest fires in Indonesia in 2015 covered Singapore and Malaysia |
| loss of **sovereignty** 主权 | global rules or companies limit what a government can decide |




*A chokepoint: when one link in the network fails, every connected place feels it*

## Building resilience

**Resilience** 恢复力 is the ability to absorb a shock and recover. It works at every scale:

| Scale | Strategy | Example |
|---|---|---|
| global | international agreements | the **Montreal Protocol** 蒙特利尔议定书 (1987) banned the gases that damage the ozone layer; it is now slowly recovering |
| national | stockpiles, more than one supplier | car makers buying chips from several countries after 2021 |
| local | early warnings, insurance, savings | text-message warnings before floods |

New technology can reduce risk (early-warning satellites, vaccines developed in under a year), but it also creates new risks, such as cyber attacks on banks and power grids.

## Answering Paper 3

**Part (a), 12 marks.** Usually "explain" or "examine" a link. Make two or three developed points, each with a named example and a number.

**Part (b), 16 marks.** An essay: "Discuss", "Evaluate" or "To what extent". Give both sides, use examples at different scales, and end with a clear judgement.

**Worked plan.** *"To what extent are global interactions good for developing countries?"*

1. For: FDI brings jobs and skills; remittances are about US$650 billion a year to low- and middle-income countries.
2. Against: the periphery receives little of the value (the farmer's 3% share); dependence on one export or one buyer.
3. Scale: national GDP may rise while some local places lose out.
4. Risk: COVID-19 showed that connected economies also share shocks.
5. Judgement: global interactions help most when governments invest in skills and spread links across many partners.

## Checklist

- The four flows with numbers; nodes and links; why connected places gain power.
- Superpowers, the G20, the UN, IMF, World Bank and WTO; TNCs and outsourcing; core and periphery; the 3% commodity-chain calculation.
- HDI (Switzerland 0.967, China 0.788, Somalia 0.380) and GII; extreme poverty.
- Cultural diffusion, homogenisation, glocalisation (KFC in China) and hybrid cultures; local responses including Fairtrade.
- The five risks with examples; chokepoints (Suez 2021); resilience at global, national and local scales (Montreal Protocol).



- Paper 3: part (a) 12 marks, part (b) 16 marks; examples at more than one scale and a clear judgement.