Course Companion

AP Human Geography

Every topic handout in one volume

全部专题讲义合集

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Thinking Geographically

AP Human Geography

Introduction to Maps

In late August 1854 cholera killed more than 500 people in ten days around Broad Street in Soho, London. The doctor John Snow marked each death as a bar on a street map and saw that the deaths clustered around one public water pump. On 8 September the parish took the pump's handle off. Snow's map is one of the most famous in history because the pattern on the map pointed to the cause. Unit 1 teaches the tools of geography: maps, data, spatial concepts, scale and regions.

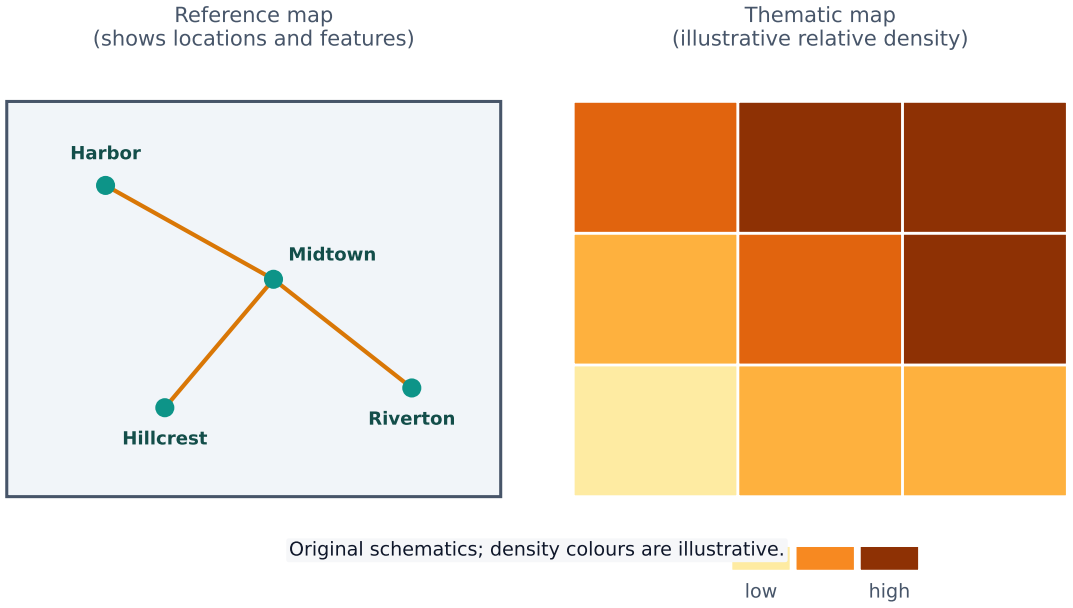
In this unit you will:

- Read and compare **reference maps** 参考地图, **thematic maps** 专题地图 and **map projections** 地图投影.
- Explain how geographers collect **geographic data** 地理数据, and how they use it.
- Use spatial concepts such as **location** 位置, **place** 地方, **distance decay** 距离衰减 and **time-space compression** 时空压缩.
- Explain human-environment interaction.
- Explain how **scale** 尺度 changes what we see, and define three kinds of **region** 区域.

A reference map shows where things are: roads, borders, cities. A thematic map shows how one variable changes across space.

Thematic map	How it shows data	Example
Choropleth map 分级统计图	Shades or colours areas by value	Income per state
Dot density map 点密度图	One dot = a set number of cases	Each dot = 1,000 people
Graduated symbol map 分级符号图	Bigger symbol = bigger value	Circles sized by city population
Isoline map 等值线图	Lines join points of equal value	Contour lines of elevation
Cartogram 变形地图	Sizes countries by a variable, not land area	Countries sized by population

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Reference maps show where things are; thematic maps show how one variable changes across space

Every flat map distorts the round Earth. The **Mercator projection** 墨卡托投影 (1569) keeps directions true, which made it useful for sailors, but it stretches areas near the poles: Greenland looks about as big as Africa, though Africa is about fourteen times larger. Equal-area projections keep areas correct but distort shapes. The Robinson projection is a compromise that distorts everything a little.

Geographic Data

Geographers collect data in two ways.

- **Field observation** 实地观察 and interviews: going to a place, counting, photographing and asking people.
- **Data from institutions:** the census (the United States has counted its population every ten years since 1790), government statistics and company records.

Technology collects data at a larger scale.

- **Remote sensing** 遥感: satellites and aircraft photograph the Earth, for example to measure forest loss in the Amazon.
- **GPS** 全球定位系统 (Global Positioning System): satellites give the exact position of a phone or vehicle, usually to within a few metres.
- A photograph can show a busy street, but it cannot tell you the population density: for that you need counts of people and area.

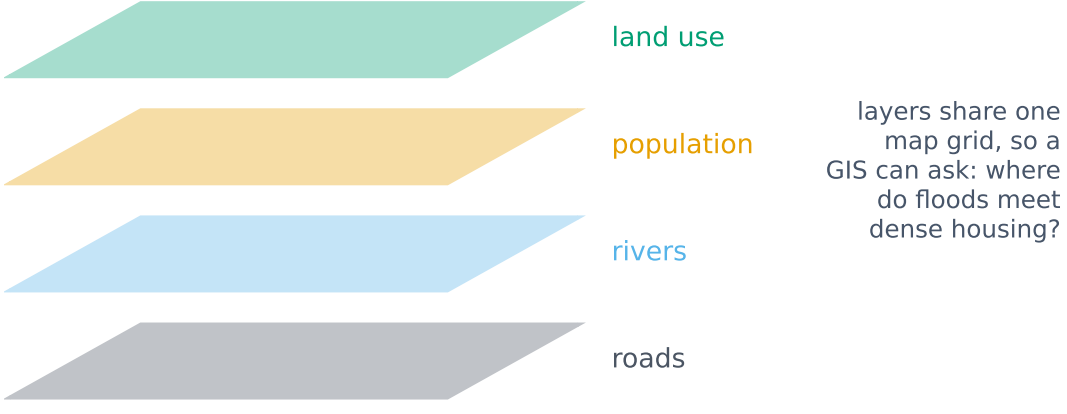
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Shibuya Crossing in Tokyo looks crowded, but a photograph cannot measure population density: that needs counts of people per square kilometre

The Power of Geographic Data

A **geographic information system (GIS)** 地理信息系统 stores data in layers on the same map, so that patterns can be compared. A city planner looking for a site for a new school could layer the homes of children under ten, existing schools, main roads and flood zones, and look for a place close to many children, far from other schools and outside the flood zone.



A GIS stacks data layers on the same map so that patterns can be compared

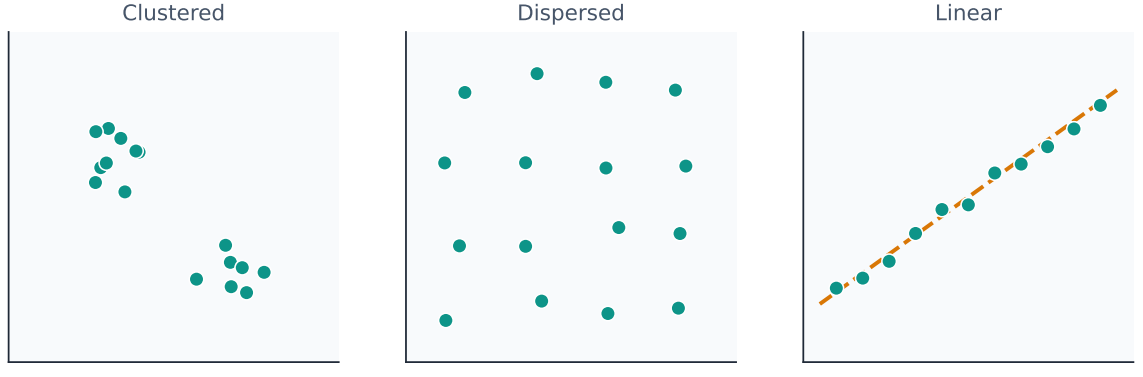
Governments and businesses use geographic data to make decisions: where to build

hospitals, where to send ambulances, where to open shops, how to draw election districts. During the COVID-19 pandemic, online maps of cases by area helped governments decide where to impose restrictions.

Spatial Concepts

- **Absolute location** 绝对位置 is a precise position, usually latitude and longitude: Beijing is at about 39.9°N, 116.4°E.
- **Relative location** 相对位置 describes a place in relation to others: Singapore lies at the southern end of the Strait of Malacca, on one of the world's busiest shipping routes.
- **Place** is what makes a location special: its people, buildings, language and feelings attached to it.
- **Distance decay**: the farther apart two places are, the less they interact. Most customers of a corner shop live within a few streets.
- **Time-space compression**: technology reduces the time it takes to cross distance. If a new train cuts a 20 km trip from 40 minutes to 20, the distance stays 20 km, but the place feels twice as close.

Things on a map form **patterns** 格局: they can be **clustered** 聚集 (shops in a city centre), **dispersed** 分散 (farms on a plain) or **linear** 线状 (towns along a river or railway).



Points can be clustered, dispersed or arranged along a line: the pattern itself is evidence

Human-Environmental Interaction

People use and change the environment, and the environment limits what people can do.

- **Natural resources** 自然资源: water, soil, forests and minerals; using them **sustainably** 可持续地 means not using them faster than they are replaced.
- **Environmental determinism** 环境决定论 is the old, rejected idea that the physical environment decides how a society develops.
- **Possibilism** 可能论 argues that the environment sets limits, but people choose how to respond: the Netherlands built dikes and reclaimed land from the sea.

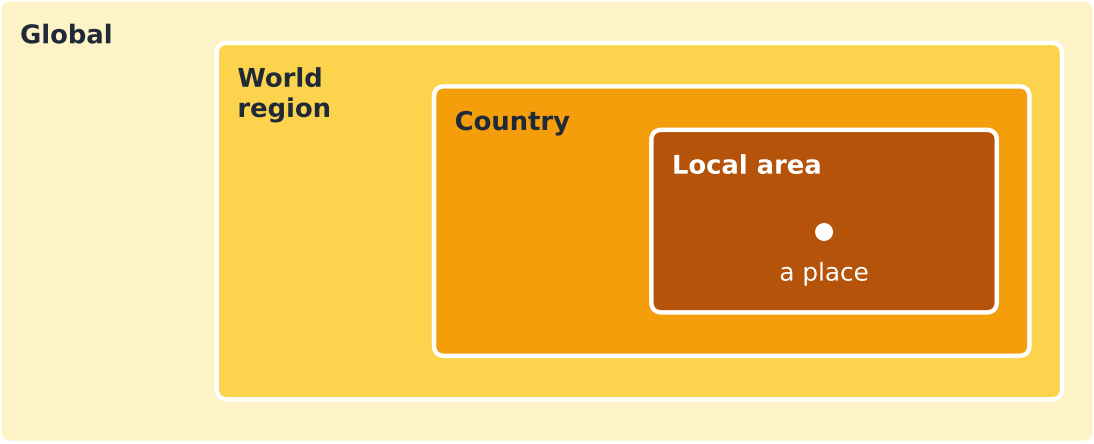


Urban sprawl at a city's edge: housing replaces farmland and forest

Scales of Analysis

Geographers study patterns at different **scales of analysis** 分析尺度: global, regional, national and local. A pattern at one scale can disappear or reverse at another.

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Illustrative nesting, not a universal hierarchy.

The same place sits inside larger and larger scales, and the scale you choose changes the pattern you see

China's national average income hides large differences between provinces, and a provincial average hides differences between cities and villages. A question about why a city is rich needs local data; a question about world trade needs global data.

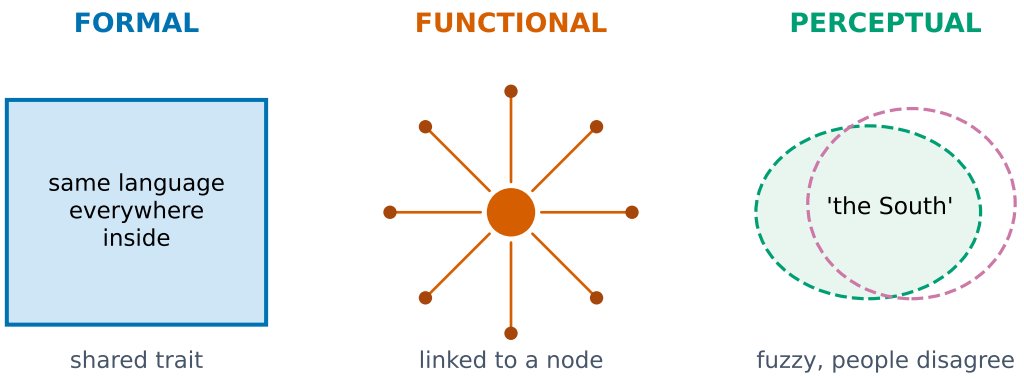
Map scale 比例尺 is different: it is the ratio of distance on the map to distance on the ground. A **large-scale map** (1:10,000) shows a small area in detail; a **small-scale map** (1:10,000,000) shows a large area with little detail.

Regional Analysis

A region is an area that shares something that makes it different from the areas around it. There are three kinds.

- **Formal region** 形式区域: everyone in it shares a measurable trait, such as a language, a crop or a political border. The US Corn Belt, where most farmland grows corn, is a formal region.
- **Functional region** 功能区域: organised around a central **node** 节点 and the connections to it, such as the area served by an airport, or the commuter area of a city.
- **Perceptual region** 感知区域 (vernacular region): defined by people's feelings and ideas, such as "the American South" or "the Midwest"; people disagree about its borders.

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Formal, functional and perceptual regions

The same place can belong to several regions. Shanghai is in the formal region where Wu Chinese is spoken, at the centre of the functional region of the Yangtze River Delta economy, and in people's idea of "eastern China".

Worked example: a free-response question

Free-response parts use command verbs. **Identify** needs a term or example; **describe** needs its features; **explain** shows how or why.

(a) Identify ONE type of thematic map that could show population by country.

(b) Describe ONE limitation of the Mercator projection.

(c) Explain how the scale of analysis can change the conclusion drawn from income data.

Model answer.

- (a) A choropleth map, shading each country by its population density.
- (b) The Mercator projection makes areas near the poles look much too large: Greenland appears similar in size to Africa, although Africa is about fourteen times larger.
- (c) At the national scale China's average income may suggest a middle-income country, but at the provincial scale it shows that eastern coastal provinces earn far more than western ones, so a national average hides regional inequality.

Worked example: reading distance decay

A shop records where its 200 customers live.

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Distance from shop	Customers
0–1 km	120
1–2 km	50
2–3 km	20
3 km or more	10

Step 1: describe the pattern. 120 of 200 customers, 60 per cent, live within 1 km; the number falls with every extra kilometre.

Step 2: name the concept. This is distance decay: interaction falls as distance increases.

Step 3: explain. Travelling farther costs more time and money, and people farther away have other shops closer to them. A delivery service would weaken the pattern: an example of time-space compression.

Common errors

- Calling every map "thematic": a road map is a reference map.
- Saying the Mercator projection is "wrong": it keeps direction true, but distorts area.
- Mixing up map scale with the scale of analysis.
- Confusing absolute location (coordinates) with relative location (position compared to other places).
- Calling a city's commuter area a formal region: it is functional, organised around a node.
- Using environmental determinism as a valid explanation.

Key terms

thematic map: A map that shows how one variable changes across space.

map projection: A way of showing the round Earth on a flat map, which always causes some distortion.

GIS: A computer system that stores and compares geographic data in layers.

remote sensing: Collecting data about the Earth from satellites or aircraft.

distance decay: The decline of interaction as distance increases.

time-space compression: The reduction in the time it takes to cross distance, due to technology.

scale of analysis: The level, from local to global, at which a pattern is studied.

functional region: A region organised around a node and the connections to it.

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Check yourself

- Which thematic map uses lines that join points of equal value?
- A shopping mall attracts shoppers from a 30 km area. What kind of region is this?
- Give one example of possibilism.

Answers: An isoline map. A functional region, organised around the mall as a node. For example, the Netherlands building dikes to reclaim land from the sea (or irrigation turning a desert into farmland).

Sources for this lesson

College Board, *AP Human Geography Course and Exam Description*, Unit 1, topics 1.1–1.7 (`syllabi/ap/ap_human_geography_CED.pdf`). Projections: USGS projection uses and the USGS working manual. Position accuracy: GPS.gov. The practice questions are written for this course, not taken from past papers.

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Population and Migration Patterns and Processes

AP Human Geography

Population Distribution and Density

On 15 November 2022 the United Nations announced that the world's population had reached eight billion. It had taken until about 1804 to reach the first billion, but only twelve years to add the last one. In the same year China's population fell for the first time in sixty years, and India was about to overtake it. Unit 2 asks where people live, how populations grow and shrink, and why people move.

In this unit you will:

- Explain **population distribution** 人口分布 and calculate three kinds of **population density** 人口密度.
- Read **population pyramids** 人口金字塔 and calculate growth rates.
- Explain the **demographic transition model** 人口转变模型 and **Malthusian theory** 马尔萨斯理论.
- Explain population policies, aging and the role of women's education.
- Explain the causes, types and effects of **migration** 迁移.

People are spread very unevenly. About two-thirds of humanity lives in four clusters: East Asia, South Asia, Europe and the north-eastern United States. People crowd into river valleys, coasts and plains with good farmland and water, such as the Nile, Ganges and Yangtze valleys; few live in deserts, high mountains or the Arctic.



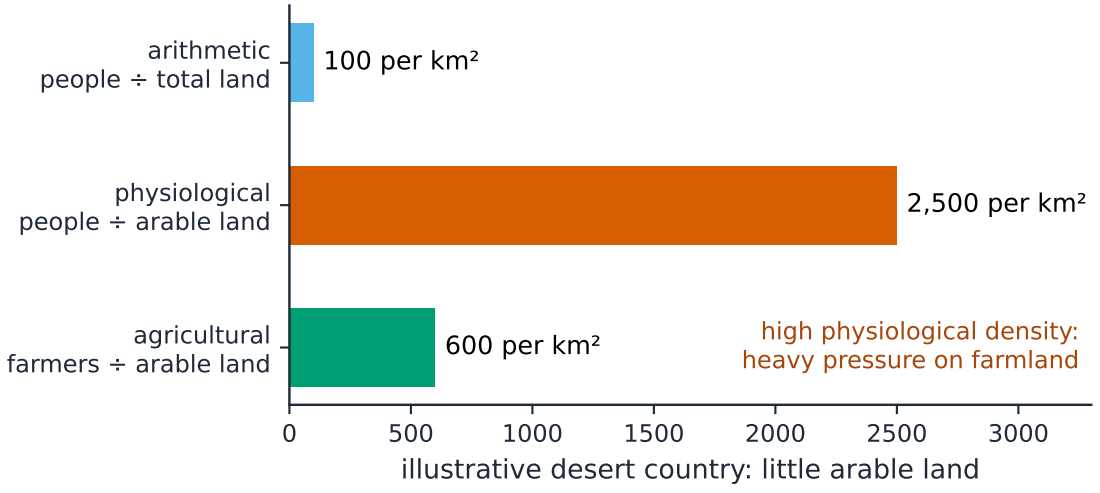
Shibuya Crossing, Tokyo: crowded at one moment, but density is measured from residents and land area, not from a photograph

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Geographers use three density measures:

- **Arithmetic density** 算术密度: total people ÷ total land area.
- **Physiological density** 生理密度: people ÷ **arable land** 耕地, the land that can be farmed. It shows the pressure on farmland.
- **Agricultural density** 农业密度: farmers ÷ arable land. A low value usually means farming is mechanised.

Egypt shows why the difference matters. About 110 million people live on about one million square kilometres, an arithmetic density of about 110 people per km^2. But only about 38,000 km^2 is arable, along the Nile, so its physiological density is about 110,000,000 ÷ 38,000 ≈ 2,900 people per km^2 of farmland.



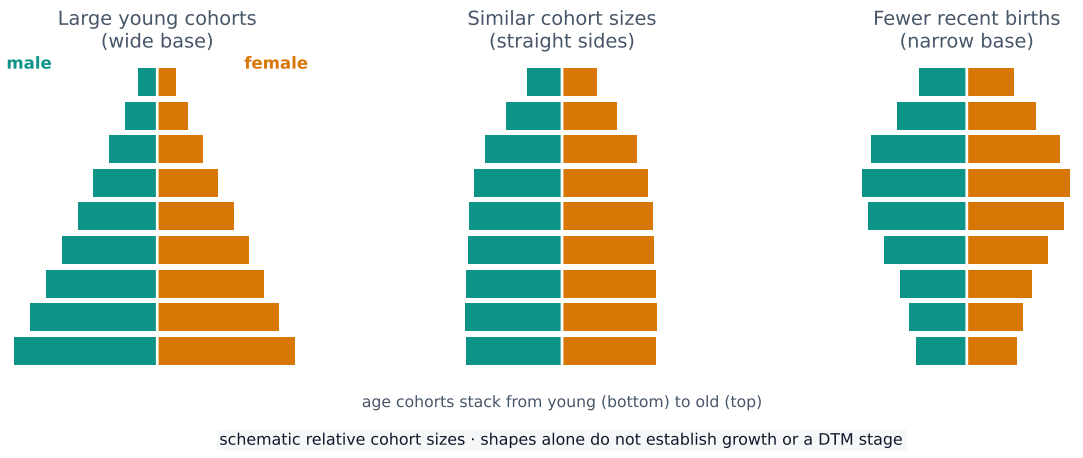
Arithmetic, physiological and agricultural density calculated for one example country

Population Composition

A population pyramid shows the population by age and sex: males on the left, females on the right, the youngest at the bottom.

- **A wide base** means many children and fast growth, as in Niger, where women have about six children each.
- **Straight sides** mean steady, slow growth, as in the United States.
- **A narrow base** means few births and an aging population, as in Japan, where about 29 per cent of people were 65 or older in 2023.

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Three age structures: a wide base (fast growth), similar cohorts (slow growth) and a narrow base (decline)

The **dependency ratio** 抚养比 compares people of working age (15–64) with those who depend on them (0–14 and 65+):

dependency ratio = (people aged 0–14 + people 65 and over) ÷ people aged 15–64 × 100.

A country with 30 million children, 10 million elderly and 60 million of working age has a ratio of $(30 + 10) \div 60 \times 100 \approx 67$: every 100 workers support about 67 dependents.

The **sex ratio** 性别比 is the number of males per 100 females. Where families prefer sons, the ratio at birth can rise well above the natural level of about 105: China's 2010 census recorded about 118 boys born for every 100 girls.

Population Dynamics

Four rates describe how a population changes.

- **Crude birth rate (CBR)** 粗出生率: births per 1,000 people per year.
- **Crude death rate (CDR)** 粗死亡率: deaths per 1,000 people per year.
- **Rate of natural increase (RNI)** 自然增长率: (CBR − CDR) ÷ 10, given as a percentage.
- **Total fertility rate (TFR)** 总和生育率: the average number of children a woman has. A TFR of about 2.1 is **replacement level** 更替水平, the rate at which a population replaces itself without migration.

Doubling time 倍增时间 is about 70 ÷ the growth rate in per cent. A country with a CBR of 30 and a CDR of 10 has an RNI of $(30 - 10) \div 10 = 2$ per cent, so it doubles in about $70 \div 2 = 35$ years.

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Population change depends on births, deaths and migration

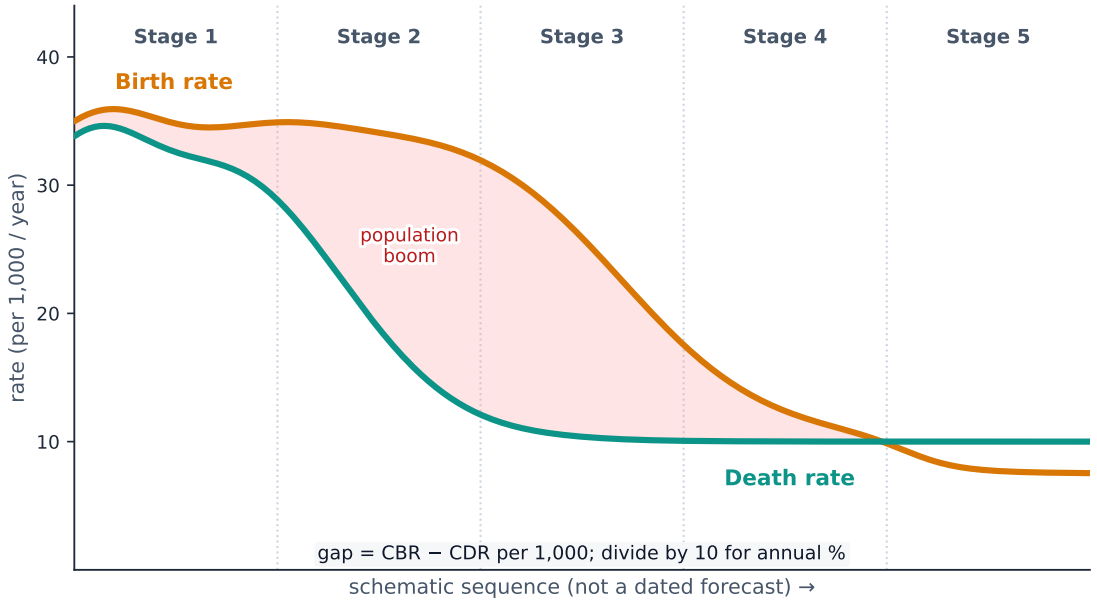
The **infant mortality rate** 婴儿死亡率, deaths of babies under one year per 1,000 live births, is one of the best measures of health care. Life expectancy has risen almost everywhere since 1950.

The Demographic Transition Model

The demographic transition model (DTM) shows how birth and death rates change as a country develops.

Stage	Birth rate	Death rate	Growth	Example
1	High	High	Very slow	No country today
2	High	Falls fast	Very fast	Niger, Chad
3	Falls	Low	Slowing	India, Mexico
4	Low	Low	Very slow	United States, China
5	Very low	Rising slightly (aging)	Decline	Japan, Italy

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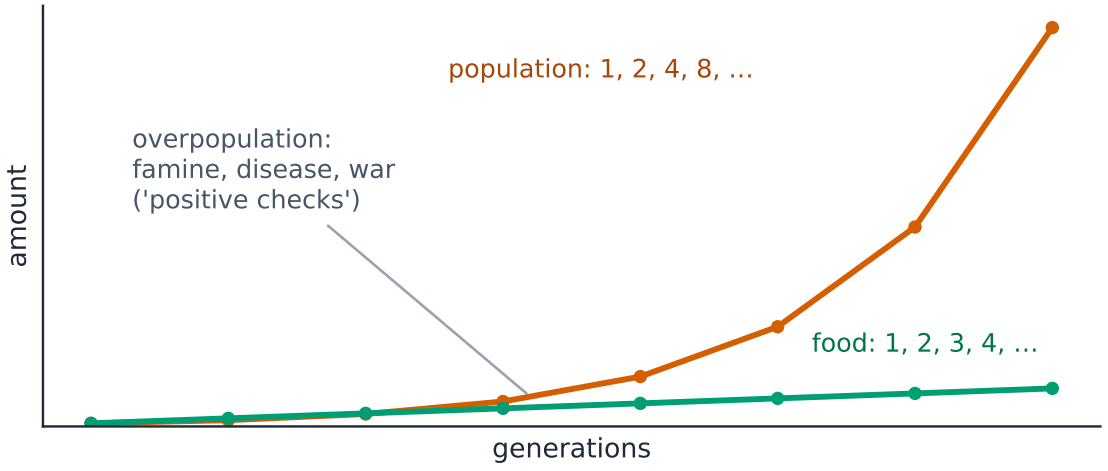
The death rate falls first, then the birth rate; the gap between them is the population boom

Death rates fall first because of clean water, vaccines and better food. Birth rates fall later, as children go to school instead of working, more people live in cities, and women have more education and jobs. Like all models, the DTM is based on the history of Europe; it does not predict exactly when, or whether, a country moves to the next stage.

The **epidemiological transition** 流行病学转变 is the matching change in causes of death: from infectious diseases in stage 2 to heart disease and cancer in stages 4 and 5.

Malthusian Theory

In 1798 Thomas Malthus argued in *An Essay on the Principle of Population* that population grows geometrically (1, 2, 4, 8 …) but food supply only arithmetically (1, 2, 3, 4 …). Population would outrun food, and famine, disease and war would follow.



critics: technology (the Green Revolution) raised food output faster than Malthus expected

Malthus: population grows geometrically, food supply only arithmetically

Malthus was wrong about his own time: food production grew faster than population, thanks to new farming methods and, in the twentieth century, the Green Revolution. Ester Boserup (1965) argued the opposite of Malthus: population pressure pushes farmers to invent better methods. **Neo-Malthusians** 新马尔萨斯主义者, such as Paul Ehrlich in *The Population Bomb* (1968), worried about resources beyond food, such as water and energy.

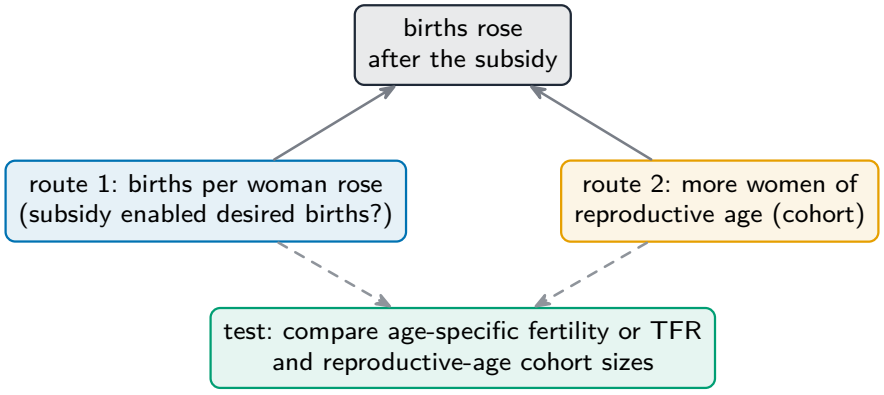
Population Policies

Governments try to change population growth.

- **Anti-natalist** 限制生育 **policies** discourage births. China's one-child policy (1980–2015) limited most urban couples to one child; Singapore's "Stop at Two" campaign (1972) used housing and tax rules.
- **Pro-natalist** 鼓励生育 **policies** encourage births where populations are aging. Singapore reversed course with a Baby Bonus from 2001; France pays generous family allowances; China moved to a two-child policy in 2016 and a three-child policy in 2021.
- **Immigration policies** decide who may enter and stay, for example Canada's points system, which selects migrants by skills, language and age.

Policies have unintended effects. China's one-child policy, together with a preference for sons, raised the sex ratio at birth, and it sped up aging. Pro-natalist policies often have small effects: South Korea's TFR fell to 0.72 in 2023 despite large spending.

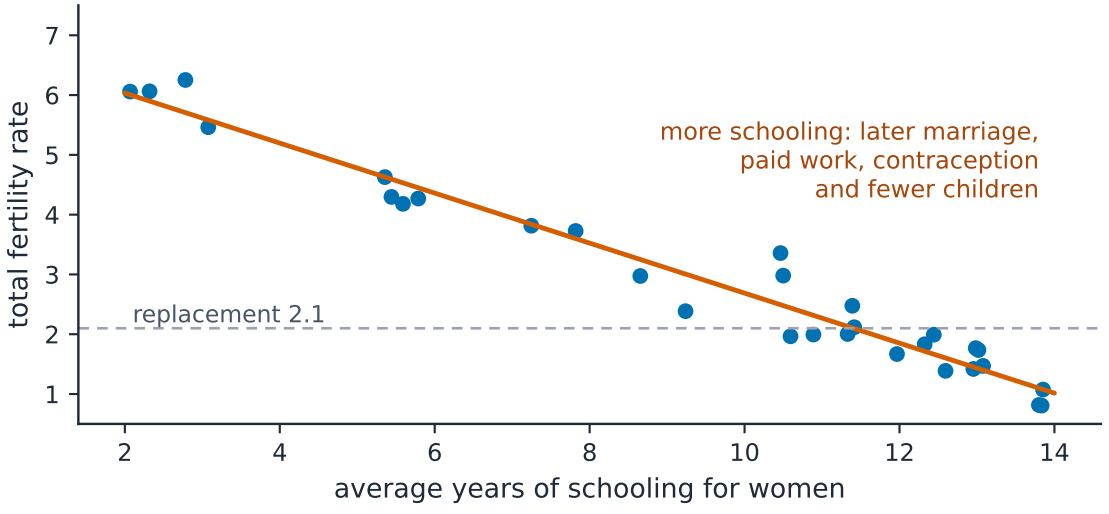
When births rise after a policy, check why: higher fertility per woman, or just more women of child-bearing age.



More births can come from higher fertility or from more people of child-bearing age; compare fertility rates and cohort sizes to tell them apart

Women, Aging, and Demographic Change

When girls stay in school longer and women work for wages, they usually marry later and have fewer children. This is one of the strongest patterns in population geography.

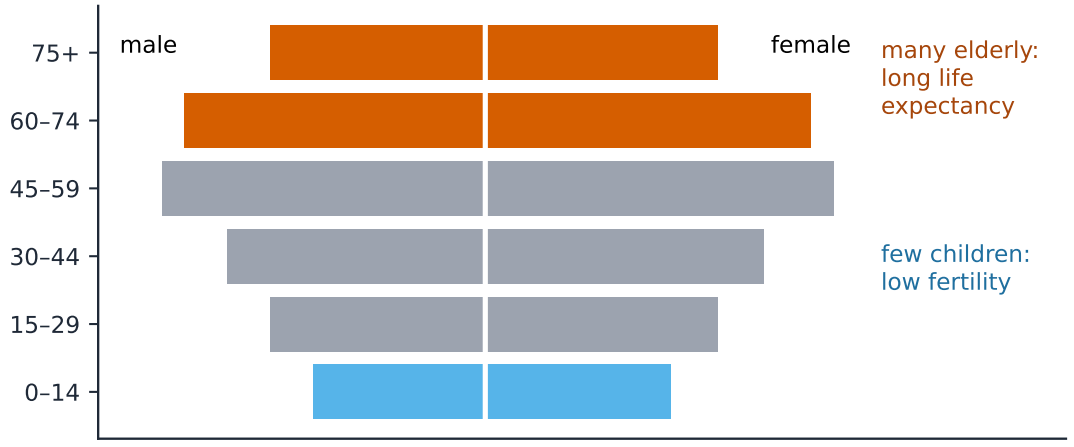


Countries where women have more schooling usually have lower fertility

An aging population changes a country.

- Fewer workers support more retired people, so pensions and health care cost more.
- Labour shortages may lead to more immigration, robots, or later retirement ages. Japan raised its pension age and now admits more foreign workers.

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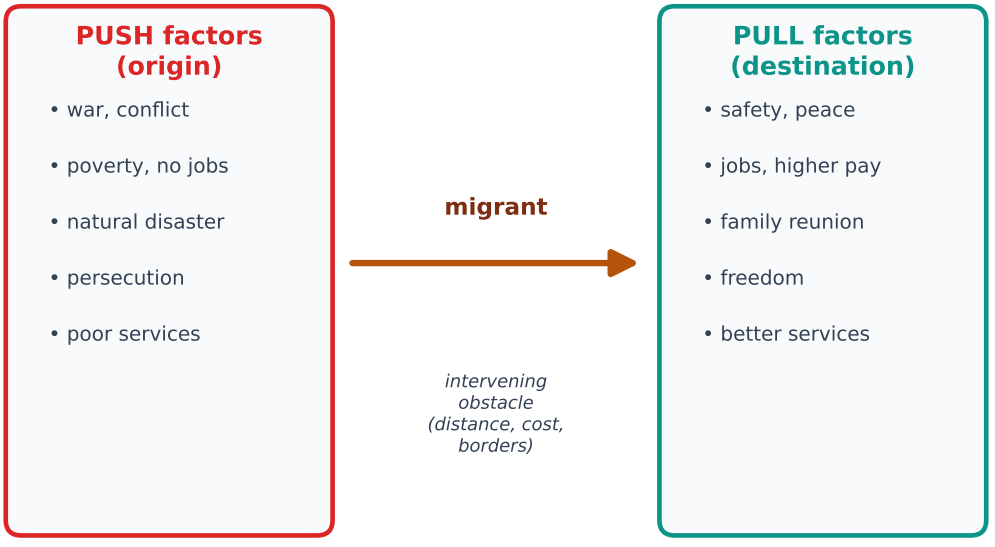


elderly dependency ratio = people 65+ ÷ people 15–64: fewer workers support each pensioner

An aging population: a top-heavy pyramid and a rising elderly dependency ratio

Causes and Types of Migration

People move because of **push factors** 推力因素 that drive them out (war, poverty, disaster) and **pull factors** 拉力因素 that draw them in (jobs, safety, family). **Intervening obstacles** 中间障碍, such as mountains, borders, cost or immigration laws, can stop them; **intervening opportunities** 中间机会 can make them settle on the way.



Migrants weigh push factors against pull factors, across intervening obstacles

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- **Forced migration** 被迫迁移: **refugees** 难民 flee across borders, such as more than six million Syrians after the civil war began in 2011, or about 700,000 Rohingya who fled Myanmar to Bangladesh in 2017. **Internally displaced persons** 境内流离失所者 flee within their own country.
- **Voluntary migration** 自愿迁移: people choose to move, usually for work.
- **Internal migration:** China's rural-to-urban migration, more than 290 million migrant workers, is the largest in history. In the US Great Migration (about 1910–1970), about six million African Americans moved from the rural South to northern cities.
- **Chain migration** 链式迁移 (following family), **step migration** 阶梯迁移 (moving in stages, village to town to city) and **guest workers** 外籍劳工, such as the Turkish workers Germany recruited from 1961.



Hungarian immigrants in Cleveland, early 1900s: many Europeans moved to work in the factories of the Great Lakes region

Ravenstein's **laws of migration** 迁移法则 (1885) observed that most migrants move short distances, that long-distance migrants go to big cities, and that each migration flow produces a counterflow.

Effects of Migration

- **Remittances** 侨汇: money migrants send home. India received about 125 billion dollars in 2023, more than any other country.
- **Brain drain** 人才外流: when skilled people, such as doctors and engineers, leave a poorer country.
- **Ethnic enclaves** 族裔聚居区 and cultural change in destination cities.

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- **Changes in the population of both places:** origin regions lose young adults and age faster; destinations gain workers and births.



Migration changes the labour market, culture and population of the places migrants reach

Worked example: a free-response question

Free-response parts use command verbs. **Identify** needs a term or example; **describe** needs its features; **explain** shows how or why.

(a) Identify the stage of the demographic transition model with high birth rates and rapidly falling death rates.

(b) Describe ONE pro-natalist policy.

(c) Explain ONE effect of an aging population on a country's economy.

Model answer.

- (a) Stage 2.
- (b) Singapore's Baby Bonus, from 2001, gives parents cash payments and savings for each child to encourage families to have more children.
- (c) As the share of people over 65 rises, fewer workers pay taxes to fund more pensions and health care, so the government must raise taxes, cut benefits or raise the retirement age.

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Worked example: growth and doubling time

A country has 40 births and 12 deaths per 1,000 people per year.
Step 1: RNI. $(40 - 12) \div 10 = 2.8$ per cent per year.
Step 2: doubling time. $70 \div 2.8 = 25$ years.
Step 3: place it in the DTM. A high birth rate with a low death rate fits stage 2: the death rate has fallen, but the birth rate has not yet.
Step 4: explain one consequence. The population will double in about 25 years, so the country must provide twice as many school places and, later, jobs.

Common errors

- Using arithmetic density when the question is about pressure on farmland: that is physiological density.
- Calculating RNI as CBR − CDR without dividing by 10 to get a percentage.
- Saying every country must pass through every DTM stage on a fixed timetable.
- Describing Malthus without the criticism, or without the difference between geometric and arithmetic growth.
- Using "hypothetical" policies: name a country and a date.
- Calling refugees economic migrants: refugees are forced to flee persecution or war.

Key terms

physiological density: The number of people per unit of arable land.

dependency ratio: The number of children and elderly people per 100 people of working age.

total fertility rate: The average number of children born to each woman.

replacement level: A total fertility rate of about 2.1, at which a population replaces itself.

demographic transition model: A model of how birth and death rates change as a country develops.

pro-natalist policy: A government policy that encourages people to have more children.

push and pull factors: Reasons that drive people from a place and draw them to another.

remittances: Money that migrants send to their home country.

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Check yourself

- Why is Egypt's physiological density much higher than its arithmetic density?
- A country has a growth rate of 1 per cent. About how long will it take to double?
- Give one forced and one voluntary migration, with places and dates.

Answers: Most of Egypt is desert; people farm only the narrow Nile valley and delta, so there are many people per km^2 of arable land. About 70 years ($70 \div 1$). Forced: Syrian refugees after 2011 (or the Rohingya, 2017). Voluntary: Chinese rural-to-urban migration, or Turkish guest workers in Germany from 1961.

Sources for this lesson

College Board, *AP Human Geography Course and Exam Description*, Unit 2, topics 2.1–2.12 (`syllabi/ap/ap_human_geography_CED.pdf`). Population figures: UN *World Population Prospects 2022*; remittances: World Bank (2023). The practice questions are written for this course, not taken from past papers.

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Cultural Patterns and Processes

AP Human Geography

Introduction to Culture

In November 1987 the first KFC in mainland China opened near Tiananmen Square in Beijing. It soon opened in other large cities, then in smaller ones, and by the end of 2023 there were more than 10,000 KFC restaurants in China. Its menu changed on the way: a Chinese KFC breakfast can be rice porridge and fried dough sticks (*youtiao*), not an American one. One company shows several ideas in this unit at once: a trait from one culture spreads, moves down from big cities to small ones, and changes to fit the culture it arrives in.

Culture 文化 is the shared set of beliefs, values, practices, and objects of a group of people. Geographers split it into two parts:

- **Material culture** 物质文化 – the things people make and use (clothing, tools, food, buildings, art).
- **Nonmaterial culture** 非物质文化 – the ideas people hold (language, religion, values, rules).

A **cultural trait** 文化特征 is a single element of culture (using chopsticks); a group of linked traits is a **cultural complex**. **Cultural relativism** 文化相对论 is the practice of judging a culture by its own standards rather than your own.



Chinatown signs: culture is shared practices, values and symbols that people learn and pass on

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Cultural Landscapes

The **cultural landscape** 文化景观 is the visible imprint of human activity on the land – buildings, farms, roads, signs, and monuments. It records the values of the people who made it.

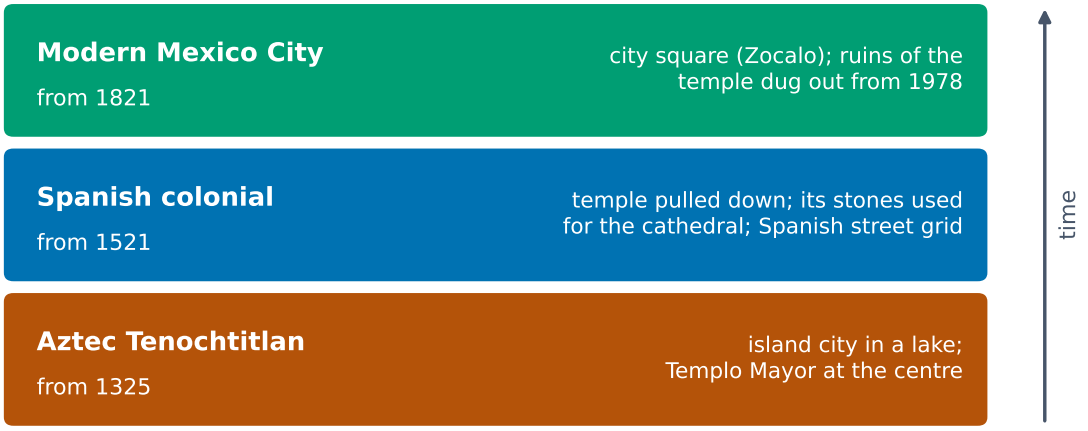
- **Sequent occupance** 承继占用 is the idea that successive groups can leave layers on the landscape. Some traces survive, while others are erased; the visible landscape does not show the whole history.
- **Ethnic enclaves** 族裔聚居区, religious buildings, and language on signs are all readable clues to who lives there and what they value.



A Chinatown gate in Seattle: the architecture and bilingual signs mark an ethnic enclave, a clear imprint of one group on the cultural landscape

- **Toponyms** 地名 (place names) are part of the landscape too: Los Angeles and San Francisco are Spanish names left by Spanish settlement in California, long after Spanish rule ended.

> **Worked example: sequent occupance in Mexico City.** The Aztec capital Tenochtitlan was built on an island in a lake from 1325, with the great temple (Templo Mayor) at its centre. After the Spanish conquest in 1521, the Spanish knocked down the temple and used its stones to build a cathedral and government buildings next to the same square, on a Spanish street grid. In 1978 electricity workers digging near the square found a huge carved Aztec stone, prompting major excavations. Parts of the temple had already been excavated in 1913. Today a visitor can stand in one place and see all three layers: Aztec ruins, a Spanish cathedral and a modern city square.



one site: the centre of Mexico City

Each group left a layer on the same place: reading them in order is sequent occupance.

Cultural Patterns

Cultures spread across space in patterns. Key ideas:

- **Centripetal forces** 向心力 pull a group together (a shared language or religion); **centrifugal forces** 离心力 push it apart.
- **Acculturation** 文化适应 (adopting some traits of another culture while keeping your own), **assimilation** 同化 (fully blending into another culture), and **syncretism** 融合 (two cultures blending into something new) describe how cultures change on contact.
- A **lingua franca** 通用语 is a common language used between groups who speak different first languages.

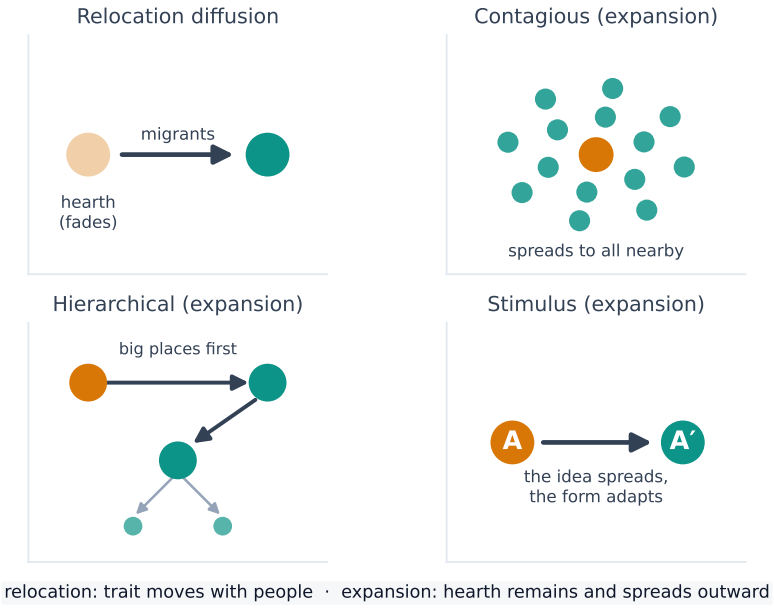


Acculturation keeps your own culture, assimilation replaces it, and syncretism blends both into something new

Worked example (a real AP exam question). *"Explain how food preferences can be a culture trait."* (2023) A full-mark answer: *"Many dishes use ingredients or ways of cooking that are unique to one culture group – for example a national dish – so choosing and eating that food expresses belonging to the group, which is what makes it a culture trait."* The command word **Explain** needs a link, not a definition: connect the food preference **to** the idea of a shared culture. Simply listing foods earns zero.

Types of Diffusion

Diffusion 扩散 is the spread of a cultural trait from its **hearth** 源地 (place of origin) to new areas. There are two big families.



Relocation diffusion moves with migrants; expansion diffusion spreads outward while staying at the source

- **Relocation diffusion** 迁移扩散 – the trait moves as **people migrate**, so it appears in the new place but may fade at the source.
- **Expansion diffusion** 扩展扩散 – the trait spreads outward while **staying strong at the source**. It has three types:
  - **Contagious** 传染扩散 – spreads person-to-person to nearby people (like a viral video).
  - **Hierarchical** 等级扩散 – jumps from big, important places to other big places first (a fashion from major cities).
  - **Stimulus** 刺激扩散 – the underlying idea spreads even if the exact trait changes (a global brand adapting its menu locally).

Worked example: name the type. For each case, ask two questions in order. First, did people carry the trait by moving (relocation), or did it spread while the people stayed put (expansion)? Second, if it is expansion, did it spread to neighbours, jump between important places, or change as it spread?

Case	Type	Why
Families from Punjab settle in Vancouver and open gurdwaras (Sikh temples)	relocation	the religion arrived because the people moved there
A dance craze spreads from one school to the schools next to it within a month	contagious	it passes to nearby people, with no jumps
A new phone first goes on sale in New York, London and Tokyo, then in smaller cities	hierarchical	it starts in the largest, best-connected places and moves down the urban hierarchy
A burger chain sells a vegetarian burger in India instead of beef	stimulus	the idea (fast-food burgers) spread, but the product changed to fit local beliefs
A slang word used by a few celebrities is soon used by young people across the country	hierarchical, then contagious	it starts with people of high status and is then copied person to person

The last row shows that one trait can spread in more than one way: say so, and give the order. A common mistake is to call anything spread by the internet "contagious": if it starts with famous people or big cities, it is hierarchical.

Causes of Diffusion

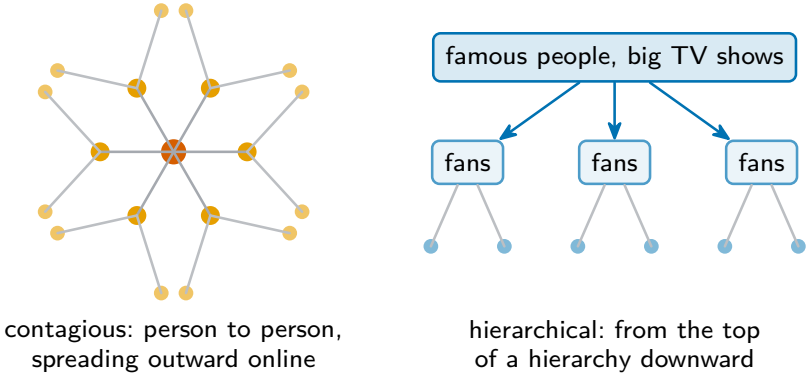
Diffusion has both **historical** and **contemporary** causes.

- **Historical**: **colonialism** 殖民主义, **imperialism** 帝国主义, trade, and the spread of religion carried culture across the world for centuries.
- **Contemporary**: **globalisation** 全球化, the internet, transport, and **time–space compression** 时空压缩 speed diffusion up enormously – a trend can now spread worldwide in hours.

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Cause	Real example	What spread
colonialism	Spanish and Portuguese rule in Latin America from the 1500s	Spanish and Portuguese; Catholic Christianity
imperialism	the British Empire in India, Africa and Australia	English as a language of government and business; cricket
trade	the Silk Roads between China and the Mediterranean	Buddhism into China; silk, paper and spices
globalisation and the internet	the **Korean Wave** 韩流 since the 2000s	K-pop, Korean dramas, food and the Korean language

Worked example: time–space compression. In 2012 the K-pop song "Gangnam Style" became the first video on YouTube to reach one billion views, about five months after its release. Earlier waves of culture took decades to cross the world by ship. Here a song spread from Seoul to almost every country in months, by **contagious** diffusion from person to person online, and **hierarchical** diffusion when famous people and big TV shows copied the dance. A **lingua franca** helps too: English on social media lets people share a trait across language borders.



Schematic: a trend can spread person to person (contagious) and from the top of a hierarchy downward (hierarchical) at the same time

These forces can spread culture but also threaten local traditions, raising debates about a global culture versus local identity.

Diffusion of Religion and Language

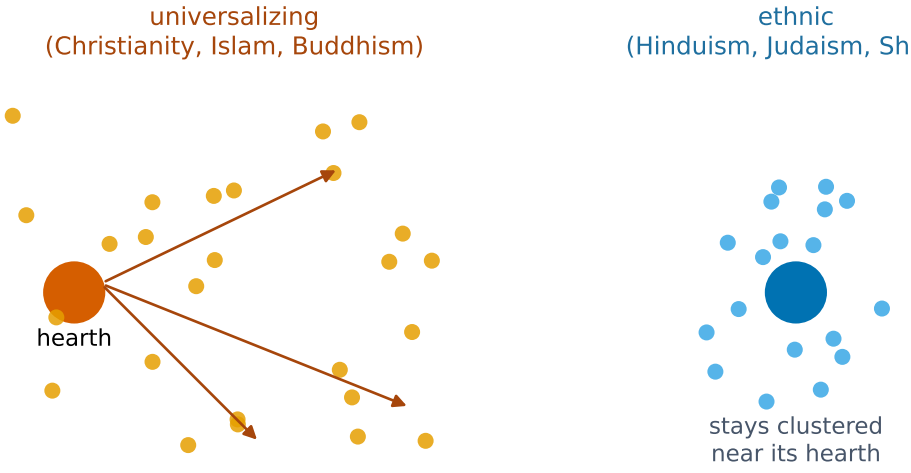
Religions and languages are the two clearest examples of cultural diffusion.

- **Universalising religions** 普世宗教 (Christianity, Islam, Buddhism, Sikhism) are open to converts beyond a single ethnic group and spread by expansion and relocation diffusion; traditions differ in their missionary activity. **Ethnic religions** 民族宗教 (Hinduism, Judaism) are tied to one group and spread mainly by relocation.
- Languages belong to **language families** 语系; they spread with migration and trade, and can split into **dialects** 方言 or die out as speakers switch to a dominant language.

Religion	Hearth	How it spread
Buddhism	northern India, about 500 BCE	missionaries and traders along the Silk Roads into China, then Korea and Japan (expansion)
Christianity	the eastern Mediterranean (Palestine)	early spread through urban networks in the Roman Empire; imperial support came later, from the fourth century; European colonial empires later carried it overseas
Islam	the Arabian Peninsula (Mecca and Medina)	conquest and trade across North Africa and the Middle East; traders by sea to Southeast Asia
Hinduism	the Indus and Ganges valleys of South Asia	mainly stays in South Asia; carried by migrants (relocation) to places such as Mauritius and the UK

The **Indo-European** language family shows language diffusion on the largest scale: its languages spread across Europe and into Iran and India. The original hearth and timing remain debated; steppe and Caucasus-related origins are among the researched models. Colonialism later carried English, Spanish, Portuguese and French to the Americas, Africa and Oceania. The family's wide distribution reflects several waves of migration and language change, not one colonial expansion.

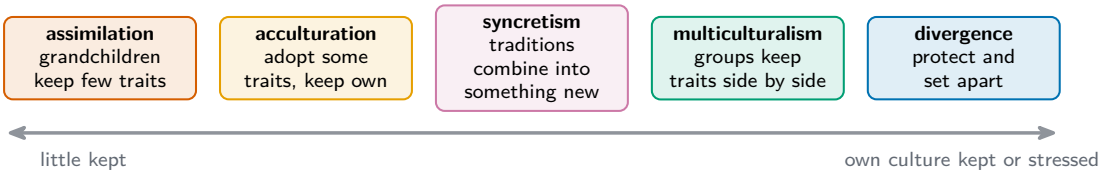
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Universalizing religions spread far from their hearths; ethnic religions stay clustered

Effects of Diffusion

When cultures spread and meet, several outcomes follow:



The outcomes in the table, from losing one's own culture (assimilation) to protecting it (divergence)

- **Cultural convergence** 文化趋同 – cultures become more alike as they share traits (global brands, English online).
- **Cultural divergence** 文化分化 – a culture becomes more distinct, often to resist outside influence.
- Diffusion can enrich a place with new food, music, and ideas, but can also erode local languages and traditions – a central tension of a globalising world.

Outcome	Real example
acculturation	Chinese students in the USA eat American food and speak English at school, but keep Chinese at home and celebrate Spring Festival
assimilation	many grandchildren of immigrants in the USA speak only English and keep few traits of their grandparents' culture
syncretism	Mexico's Day of the Dead combines Indigenous and Catholic traditions; their contributions vary by community and their historical origins are debated
multiculturalism 多元文化	in Singapore, Chinese, Malay, Indian and Eurasian groups keep their own traits side by side, with four official languages
divergence	France requires about 40% of songs on music radio to be in French, and Quebec requires French on shop signs, to protect their own language

Worked example: a free-response question

Free-response parts are scaffolded by their command verbs. **Identify** needs a term or example; **describe** needs its features; **explain** shows how or why, supported by evidence or reasoning. Give a specific example when the prompt asks for one.

Answer (a), (b) and (c).

(a) Identify ONE example of relocation diffusion.

(b) Describe hierarchical diffusion.

(c) Explain ONE way globalisation can threaten a local culture.

Model answer.

- (a) Migrants from China carrying their language and cuisine to cities such as San Francisco.
- (b) A trait spreads from large or powerful places to smaller ones, for example a fashion moving from global cities to smaller towns.
- (c) Global media and brands can replace local products and languages, so younger people adopt a global popular culture instead of local traditions.

Exam tips

- Distinguish **relocation diffusion** (people move) from **expansion diffusion** (the idea spreads and stays at its source).
- Name the expansion sub-type precisely: **contagious**, **hierarchical**, or **stimulus**.
- Separate **universalizing religions** (seek converts) from **ethnic religions** (spread mainly by birth).

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- Use the **cultural landscape** – architecture, **toponyms**, **sequent occupance** – as evidence of past groups.
- For effects, keep **acculturation**, **assimilation**, and **syncretism** distinct; they are not the same.

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Political Patterns and Processes

AP Human Geography

Introduction to Political Geography

On 25 December 1991 Mikhail Gorbachev resigned as president of the Soviet Union, and the next day the country formally ceased to exist. Fifteen independent states, from Estonia to Kazakhstan, took its place, each with its own borders, army and seat at the United Nations. Unit 4 asks how the world is divided into states, how boundaries are drawn, how states are governed, and what forces hold them together or pull them apart.

In this unit you will:

- Distinguish a **state** 国家, a **nation** 民族 and a **nation-state** 民族国家.
- Explain how colonialism, imperialism and independence movements shaped today's map.
- Classify **boundaries** 边界 and explain how they are drawn and disputed.
- Compare **unitary** 单一制 and **federal** 联邦制 states.
- Explain **devolution** 权力下放, **supranationalism** 超国家主义 and the forces that unite or divide states.

Three ideas are easy to confuse.

- A **state** is a territory with a permanent population, a government and **sovereignty** 主权: no outside power controls its affairs. The idea of sovereign states dates from the Peace of Westphalia (1648). The UN has 193 member states.
- A **nation** is a group of people who share a culture, language or history and see themselves as one people.
- A **nation-state** is a state whose people are mostly one nation, such as Japan or Iceland.

Other combinations are common:

- A **multinational state** 多民族国家 contains several nations, such as Russia or the United Kingdom (England, Scotland, Wales and Northern Ireland).
- A **multistate nation** 跨国民族 lives in more than one state, such as Koreans in North and South Korea.
- A **stateless nation** 无国家民族 has no state of its own: the Kurds, perhaps 30 to 40 million people, live mainly in Turkey, Iraq, Iran and Syria.
- An **autonomous region** 自治区 governs itself in some matters inside a state, as Greenland does within Denmark.

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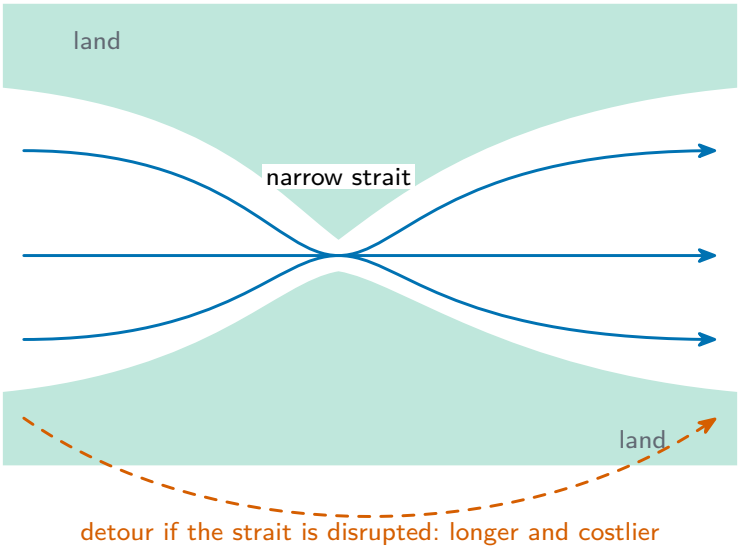
The UN General Assembly: each of the 193 member states has one vote

Political Power and Territoriality

Territoriality 领土意识 is the effort to control an area and the people in it. Today's map was shaped by:

- **Colonialism** 殖民主义 and **imperialism** 帝国主义: European states ruled most of Africa and much of Asia by 1914.
- **Independence movements:** most colonies won independence between 1945 and 1975; Ghana in 1957, Algeria in 1962.
- **Neocolonialism** 新殖民主义: powerful states and companies keep economic control over former colonies without ruling them.

Some places matter more because of where they are. A **choke point** 咽喉要道 is a narrow passage that much trade must pass through. About a fifth of the world's oil passes through the Strait of Hormuz, and when the container ship *Ever Given* blocked the Suez Canal for six days in March 2021, hundreds of ships queued at each end.



A choke point: many shipping routes squeeze through one narrow passage, so blocking it forces long, costly detours

A **shatterbelt** 破碎地带 is a region caught between outside powers and divided inside, such as the Balkans before 1914.

Political Boundaries

A boundary goes through four steps: **defined** (written in a treaty), **delimited** (drawn on a map), **demarcated** (marked on the ground with posts, fences or walls) and **administered** (controlled by officials).

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Type	Definition	Example
Antecedent boundary 先成边界	Drawn before many people lived there	US–Canada border west of the Great Lakes
Subsequent boundary 后成边界	Drawn after an area was settled, as its cultural landscape developed	The China–Vietnam border
Consequent boundary 结果边界	Drawn to separate cultural groups	The 1947 India–Pakistan border, based on religion
Superimposed boundary 强加边界	Forced on an area by outside powers	Many African borders drawn by Europeans after 1884
Geometric boundary 几何边界	A straight line, often of latitude	The 49th parallel (US–Canada); the 22nd parallel (Egypt–Sudan)
Relic boundary 遗迹边界	No longer works, but still visible	The Berlin Wall's remains; the Great Wall of China

At sea, the **UN Convention on the Law of the Sea** 联合国海洋法公约 (1982) gives each coastal state **territorial waters** 领海 of 12 nautical miles and an **exclusive economic zone (EEZ)** 专属经济区 of 200 nautical miles, where it controls fishing, oil and gas. Overlapping claims cause disputes, as in the South China Sea.

A state's **shape** also matters.

- **Compact** 紧凑型 (Poland): easy to govern and defend.
- **Elongated** 狭长型 (Chile, about 4,300 km long): far regions are hard to connect.
- **Fragmented** 破碎型 (Indonesia, about 17,000 islands): hard to unify.
- **Perforated** 穿孔型 (South Africa, which surrounds Lesotho).
- **Prorupted** 突出型 (Thailand, with a long arm down the Malay Peninsula).

About 44 states are **landlocked** 内陆国, with no coast, and depend on neighbours for access to ports.

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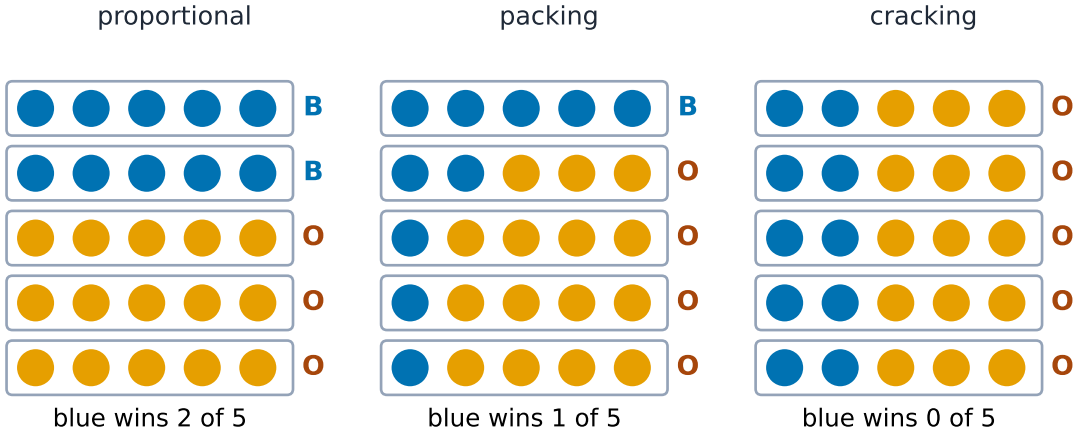
Compact, elongated, fragmented, perforated and prorupted state shapes

Internal boundaries and voting

Inside a state, boundaries divide provinces, counties and voting districts. In the United States the census every ten years decides how many of the 435 House seats each state gets (**reapportionment** 议席重新分配), and states then redraw district lines (**redistricting** 重划选区).

Gerrymandering 选区划分不公 is drawing district lines to help one party. It is named after Massachusetts governor Elbridge Gerry, whose 1812 district looked like a salamander. Two methods:

- **Packing** 集中: putting as many opposing voters as possible into one district, so they win it by a huge margin but lose everywhere else.
- **Cracking** 分散: splitting opposing voters across many districts, so they are a minority in each.



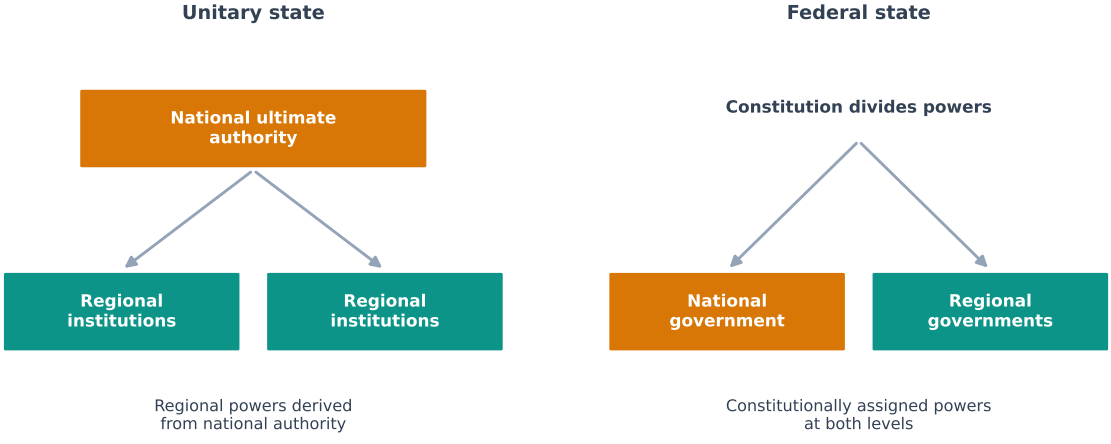
Gerrymandering: the same voters, three ways to draw five districts

Forms of Governance

- A **unitary state** 单一制国家 concentrates power in the central government: France, Japan and China. Unitary government suits states with one main nation and a strong national identity.
- A **federal state** 联邦制国家 shares power between the central government and states or provinces, each with its own laws: the United States, Germany, India, Brazil and Nigeria. Federal systems suit large states and states with many nations, because regions can govern their own affairs.



The Hungarian Parliament in Budapest: Hungary is a unitary state



In a unitary state power flows down from the centre; in a federal state the regions have their own constitutional powers

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Devolution and Challenges to Sovereignty

Devolution is the transfer of power from a central government to regions. It can be peaceful or violent.

- **Peaceful devolution:** the United Kingdom created a Scottish Parliament in 1999. In a 2014 referendum, 55 per cent of Scottish voters chose to stay in the UK.
- **Disputed devolution:** Catalonia held an independence referendum in 2017 that Spain's courts ruled illegal.
- **Break-up:** Yugoslavia split violently into seven states between 1991 and 2008, a process called **balkanisation** 巴尔干化. South Sudan became independent from Sudan in 2011.

The causes of devolution are **ethnic separatism** 民族分离主义, physical distance from the capital, and economic differences: Catalonia is one of Spain's richest regions and pays more in taxes than it receives.



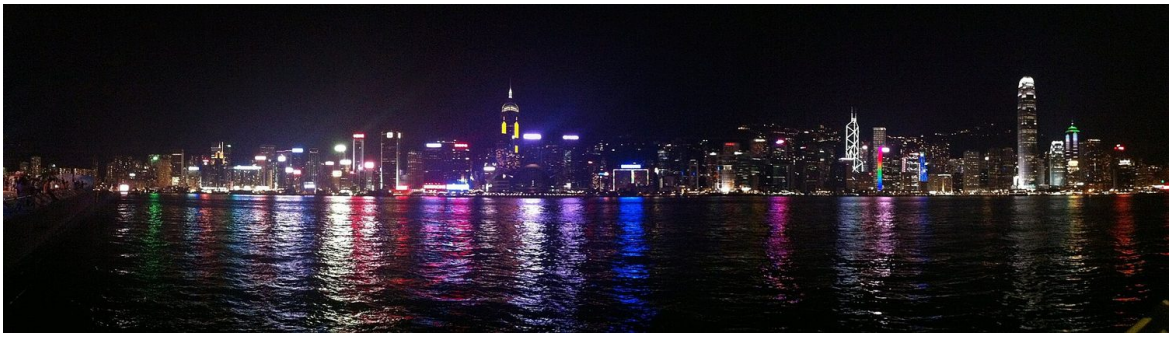
The US–Mexico border fence: a demarcated boundary that a state uses to control who enters its territory

Other forces also challenge sovereignty:

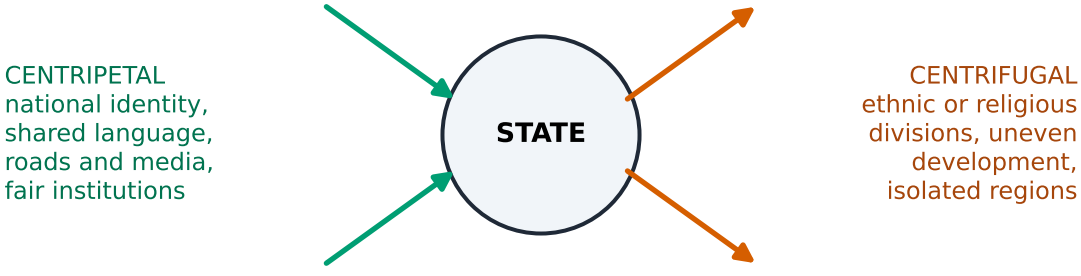
- **Supranational organisations** 超国家组织: members give up some power. The European Union has shared laws and, for most members, one currency; the United Kingdom voted to leave in 2016 and left in 2020. Others include NATO, ASEAN and the African Union.
- **Irredentism** 领土收复主义: a state claims territory in another state where people of its nation live. Russia annexed Crimea from Ukraine in 2014.
- **Terrorism** 恐怖主义 and **technology:** the internet and social media let movements organise across borders.

Centrifugal and Centripetal Forces

- **Centrifugal forces** 离心力 divide a state: different languages, religions or ethnic groups, unequal development, or a weak government. Belgium is divided between Dutch-speaking Flanders and French-speaking Wallonia, and once went 541 days without a national government (2010–2011).
- **Centripetal forces** 向心力 unify a state: nationalism, a shared language or religion, national schools, transport links and strong institutions.



Hong Kong, a special administrative region of China since 1997, keeps its own legal system under "one country, two systems"



Centripetal forces unify a state; centrifugal forces divide it

Worked example: a free-response question

Free-response parts use command verbs. **Identify** needs a term or example; **describe** needs its features; **explain** shows how or why.

(a) Identify ONE example of a stateless nation.

(b) Describe a superimposed boundary.

(c) Explain ONE way devolution can challenge state sovereignty.

Model answer.

- (a) The Kurds, who live mainly in Turkey, Iraq, Iran and Syria.
- (b) A superimposed boundary is drawn by outside powers without regard to the people living there, such as many African borders drawn by European states after the Berlin Conference.
- (c) When a region gains its own parliament, as Scotland did in 1999, it controls some laws; if it then votes for independence, the central state could lose part of its territory.

Worked example: packing and cracking

A state has 50 voters: 30 for party A and 20 for party B. It must draw five districts of 10 voters each.

Step 1: proportional result. B has 40 per cent of the vote, so a fair map might give it 2 of 5 seats.

Step 2: cracking B. Put 6 A voters and 4 B voters in every district. A wins all five districts, 6–4. B wins no seats with 40 per cent of the vote.

Step 3: packing A. Put 10 A voters in district 1 and 10 A voters in district 2; split the last 10 A voters and 20 B voters into districts of 4 A + 6 B, 3 A + 7 B and 3 A + 7 B. A wins only two seats with 60 per cent of the vote, and B wins three.

Step 4: explain. The same voters produce 5–0 for A or 3–2 for B depending only on where the lines go. That is why redistricting is so fiercely fought.

Common errors

- Using “nation” and “state” as if they meant the same thing.
- Calling every straight boundary superimposed: it is geometric; it may also be superimposed.
- Saying federal states are “weaker”: they divide power in a different way.
- Mixing up devolution (power moves down to regions) with supranationalism (power moves up to an international body).
- Explaining gerrymandering without naming packing or cracking.
- Giving centrifugal forces without a named state.

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Key terms

sovereignty: A state's full control over its own territory and affairs.

nation-state: A state whose people mainly belong to one nation.

stateless nation: A nation without a state of its own.

superimposed boundary: A boundary drawn by outside powers.

exclusive economic zone: The sea within 200 nautical miles of a coast, where a state controls resources.

federal state: A state that divides power between a central government and regional governments.

devolution: The transfer of power from a central government to regions.

centripetal force: Anything that unifies a state.

Check yourself

- Give one example each of a nation-state and a multinational state.
- What is the difference between territorial waters and an EEZ?
- Name one supranational organisation and one country that left one.

Answers: Nation-state: Japan (or Iceland); multinational state: Russia (or the United Kingdom). Territorial waters reach 12 nautical miles and are fully part of the state; the EEZ reaches 200 nautical miles and gives control over resources only. The European Union; the United Kingdom left it in 2020.

Sources for this lesson

College Board, *AP Human Geography Course and Exam Description*, Unit 4, topics 4.1–4.10 (`syllabi/ap/ap_human_geography_CED.pdf`). The practice questions are written for this course, not taken from past papers.

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Agriculture and Rural Land-Use Patterns and Processes

AP Human Geography

Introduction to Agriculture

In the mid-1960s two failed monsoons left India dependent on shipments of American grain, and many experts predicted famine. Instead, farmers in Punjab planted new short-stemmed wheat bred by Norman Borlaug, with fertiliser and irrigation, and India's wheat harvest rose from about 12 million tonnes in 1965 to about 20 million tonnes in 1970. Unit 5 asks how farming began and changed, why different places grow different things, and what modern agriculture costs people and the environment.

In this unit you will:

- Classify farming as intensive or extensive, and subsistence or commercial.
- Explain rural settlement patterns and land survey methods.
- Explain the agricultural revolutions, from the first hearths to the **Green Revolution** 绿色革命.
- Apply the **von Thünen model** 杜能模型 and explain the global food system.
- Explain the environmental and social consequences of agriculture, and the role of women in farming.

Farming is classified in two ways.

- **Subsistence agriculture** 自给农业 feeds the farmer's own family; **commercial agriculture** 商业农业 produces food for sale.
- **Intensive agriculture** 集约农业 uses a lot of labour or money on a small area (rice paddies in southern China, market gardens near cities); **extensive agriculture** 粗放农业 uses little labour or money on a large area (cattle ranching in Australia, **nomadic herding** 游牧 in Mongolia, **shifting cultivation** 迁移农业 in tropical forests).

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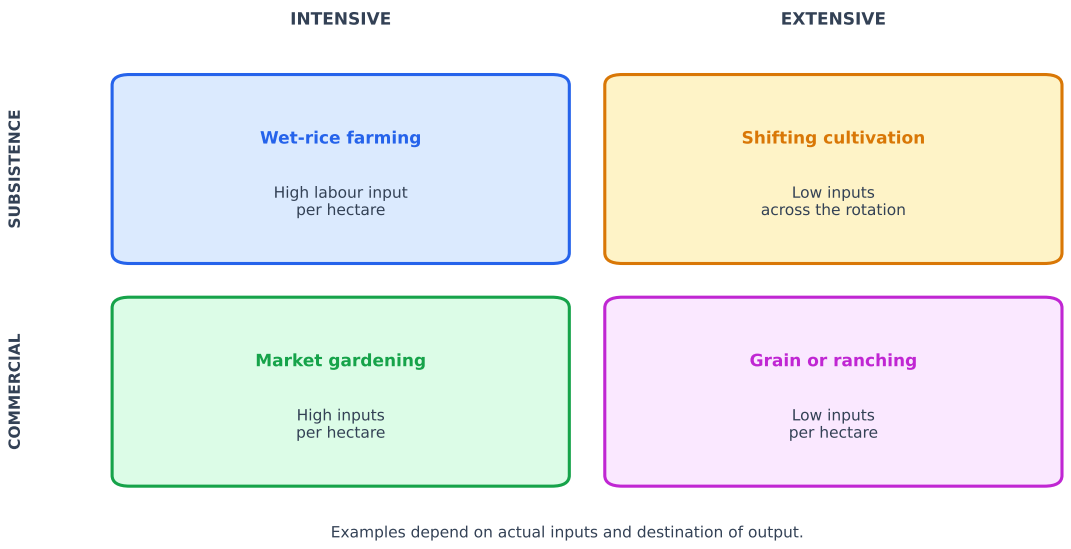


A combine harvester: commercial farming replaces workers with machines



Farming with a hoe: subsistence farmers often rely on hand tools and family labour

Climate decides much of what can be grown: rice needs heat and water, wheat grows on cooler, drier plains, and herding is often the only use for very dry land.



Farming types arranged by intensity (inputs per hectare) and purpose (subsistence or commercial)

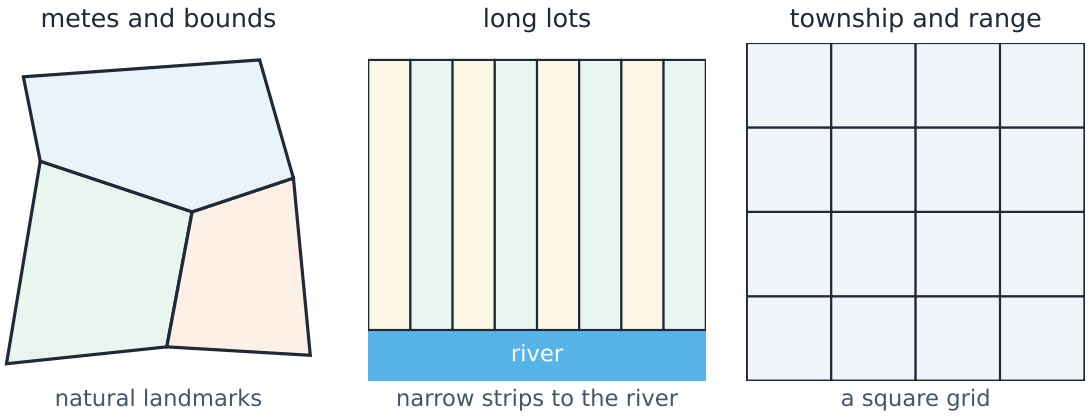
Settlement Patterns and Survey Methods

Rural settlements can be **clustered** 聚集 (farmers live in a village and walk to their fields, common in Europe and China), **dispersed** 分散 (each family lives on its own farm, as on the US Great Plains) or **linear** 线状 (houses along a road or river).

The way land was divided still shapes the landscape.

- **Metes and bounds** 地界法: boundaries follow natural features such as streams, trees and rocks, producing irregular plots. It was used in the original thirteen American colonies.
- **Long lots** 长条地块: narrow strips running back from a river, so every farm had river access. French settlers used them in Quebec and Louisiana.
- **Township and range** 方格法: the US Land Ordinance of 1785 divided the West into squares six miles on a side, each split into 36 sections of one square mile. Flying over Iowa, you can still see the grid.

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Three land survey patterns: metes and bounds, long lots, township and range

Agricultural Origins and Revolutions

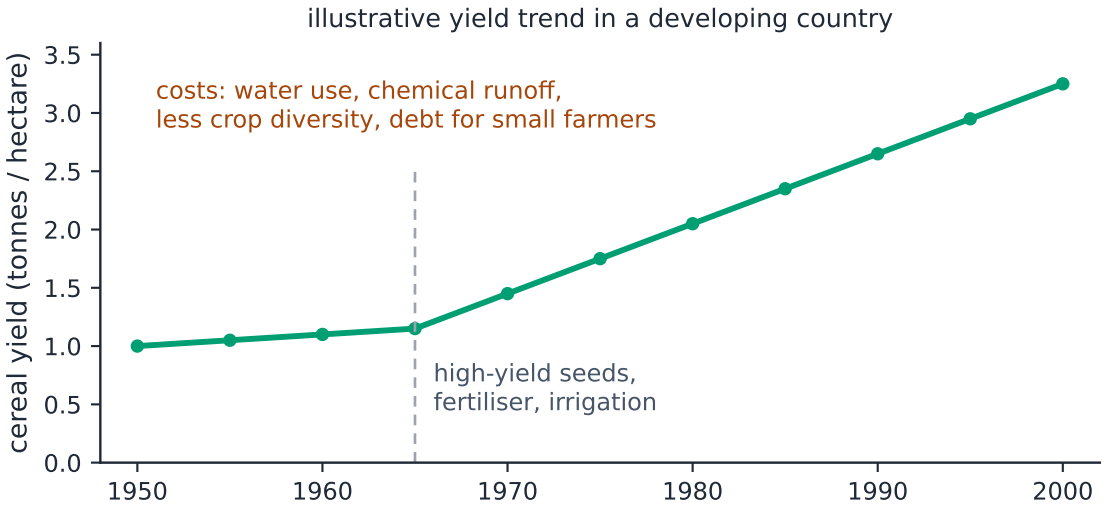
Farming began independently in several **agricultural hearths** 农业发源地 about 10,000 years ago: the Fertile Crescent (wheat, barley, goats and sheep), the Indus River Valley, Southeast Asia (rice, taro), Central America (maize, beans, squash), the Andes (potatoes) and West Africa (sorghum, yams).

- The **First Agricultural Revolution** 第一次农业革命 (the Neolithic) was the change from hunting and gathering to farming. A reliable food supply let people settle in villages and populations grow.
- The **Second Agricultural Revolution** 第二次农业革命 began in Britain in the 1700s: crop rotation, Jethro Tull's seed drill (1701), the **enclosure** 圈地 of open fields, and later tractors and chemical fertilisers. It freed workers to move to factories.
- **The Green Revolution** (from the 1960s) spread **high-yield varieties** 高产品种 of wheat and rice, with fertiliser, pesticides and irrigation, especially in India, Mexico and the Philippines.

The **Columbian Exchange** 哥伦布大交换 after 1492 moved crops and animals between the Americas and the rest of the world: maize, potatoes and tomatoes went east; wheat, cattle, horses and sugar went west.

The Green Revolution had costs. Punjab's farmers pumped so much water that groundwater levels fell, fertiliser runoff polluted rivers, and the seeds and chemicals favoured farmers who could afford them.

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The Green Revolution raised yields, but also brought environmental and social costs

Agricultural Production Regions

Each farming region depends on climate, culture and distance to market.

- **Plantations** 种植园 grow one cash crop for export in tropical regions, such as tea in Sri Lanka and Kenya, or bananas in Ecuador.
- **Mediterranean agriculture** 地中海农业 grows olives, grapes and citrus in dry summers and mild winters, in southern Europe and California.
- **Mixed crop and livestock** farming in the US Midwest grows corn and soybeans, mostly to feed animals.
- **Dairying** 乳业 locates close to cities because fresh milk spoils quickly.

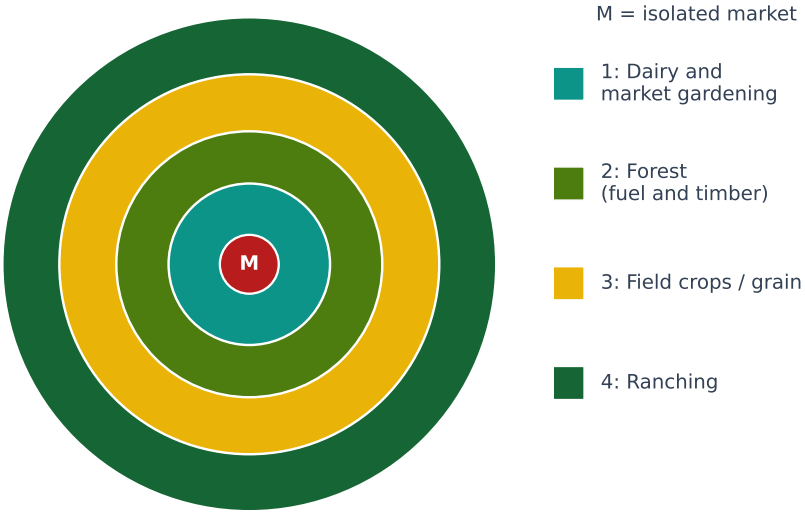


A tea plantation: a large estate specialising in one crop, often for export

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Spatial Organization and the Von Thünen Model

In *The Isolated State* (1826) Johann Heinrich von Thünen asked why farmers around one market town grew different things at different distances. His answer was **bid-rent** 竞租: land near the market is expensive and transport is cheap, so farmers there grow crops that are heavy, perishable or high-value; farther out, only cheap-to-transport uses pay.



Von Thünen's rings around a market: market gardens and dairy, forest, field crops, then ranching

1. **Market gardening and dairying** 市场园艺与乳业: perishable goods, closest to the city.
2. **Forest:** wood for fuel and building was heavy, so it was close (in 1826).
3. **Grains and field crops:** lighter and easier to store.
4. **Ranching:** cattle could walk to market.

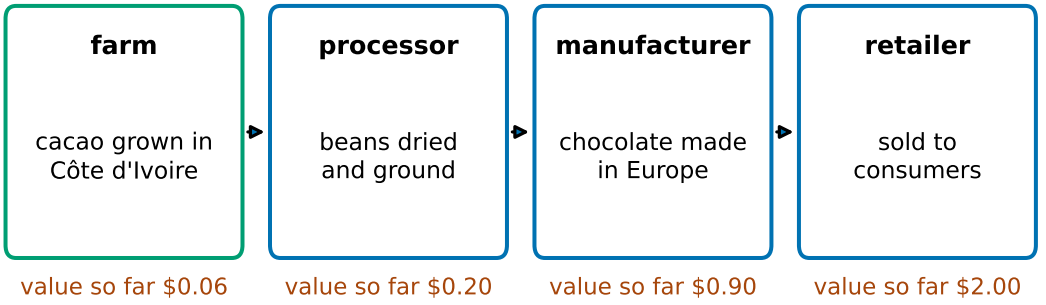
The model assumes flat land, one market and one form of transport. Today refrigerated trucks and air freight bend the rings: roses grown in Kenya are flown overnight to the flower auction in the Netherlands.

The Global System of Agriculture

Farming is now part of a global system.

- **Agribusiness** 农业综合企业: large companies control seeds, fertiliser, processing and sales.
- **Commodity chains** 商品链 link the farmer to the consumer, and most of the value is added after the farm, by processors, shippers and shops.

- **Monoculture** 单一种植 and **cash crops** 经济作物: Côte d'Ivoire grows about 40 per cent of the world's cocoa, so its economy rises and falls with the cocoa price.
- **Subsidies** 补贴 in rich countries lower world prices, which can hurt farmers in poorer ones.
- **Fair trade** 公平贸易 labels promise farmers a minimum price.



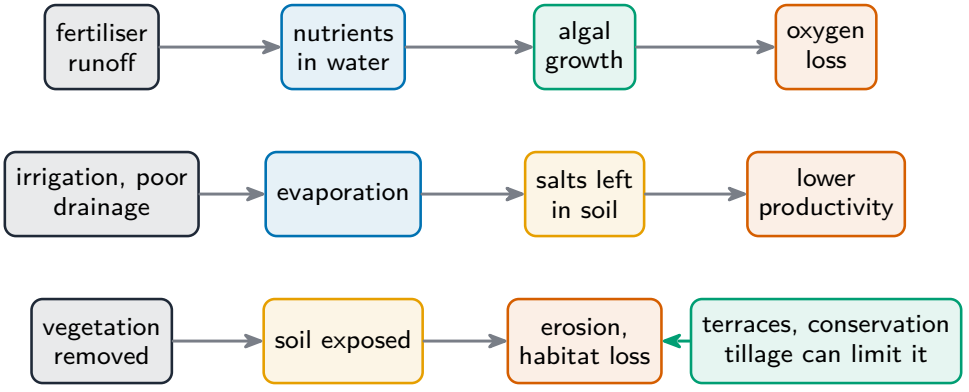
illustrative: most of the value is added far from the farm, in core countries

A commodity chain: most of the value is added after the food leaves the farm

Consequences and Challenges of Agriculture

Each farming practice has its own consequence.

- **Desertification** 荒漠化: overgrazing and drought turned land into desert in the Sahel.
- **Salinisation** 盐碱化: irrigation without drainage leaves salt in the soil. Soviet cotton irrigation drained the rivers feeding the Aral Sea, which shrank to a fraction of its size.
- **Soil erosion:** ploughing the dry Great Plains led to the Dust Bowl of the 1930s.
- **Eutrophication** 富营养化: fertiliser runoff feeds algae that use up the oxygen in water, creating the "dead zone" in the Gulf of Mexico every summer.
- **Deforestation:** forest in the Amazon is cleared for cattle and soybeans.



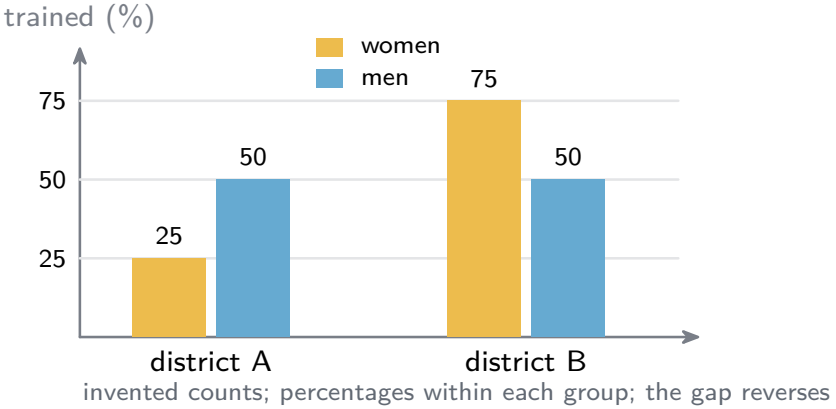
Trace each practice to its consequence: runoff, salinisation and erosion follow different chains

Food choices are changing too. **Food deserts** 食物荒漠 are urban areas with no shop selling fresh, affordable food. Responses include urban farming, organic farming, local food movements and **genetically modified organisms (GMOs)** 转基因生物, which raise yields but worry some consumers.

Women in Agriculture

Women do a large share of farm work worldwide, especially in sub-Saharan Africa, but they own less land and get less credit, training and fertiliser than men. The UN Food and Agriculture Organization estimated in 2011 that if women farmers had the same resources as men, they could raise yields on their farms by 20 to 30 per cent.

Programmes that train women farmers and give them land titles or credit can raise both harvests and family incomes.



Training participation in two example districts: women trail men in district A and lead in district B

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Worked example: income after the Green Revolution

A farmer switches to a high-yield variety. Yield rises from 3 to 5 tonnes per hectare, but the price falls from 200 to 150 dollars per tonne, and costs of seed, fertiliser and water rise from 250 to 600 dollars per hectare.

Step 1: revenue = yield × price. Before: $3 \times 200 = 600$ dollars per hectare. After: $5 \times 150 = 750$ dollars per hectare.

Step 2: net income = revenue − costs. Before: $600 - 250 = 350$ dollars per hectare. After: $750 - 600 = 150$ dollars per hectare.

Step 3: explain. The harvest grew by two-thirds, yet the farmer earns less than half as much, because inputs cost more and bigger harvests lowered the price. This is why the Green Revolution often helped richer farmers, who could afford inputs and farm more land, more than poorer ones.

Worked example: a free-response question

Free-response parts use command verbs. **Identify** needs a term or example; **describe** needs its features; **explain** shows how or why.

(a) Identify ONE agricultural hearth.

(b) Describe the land use closest to the market in the von Thünen model.

(c) Explain ONE environmental consequence of irrigation.

Model answer.

- (a) The Fertile Crescent in Southwest Asia, where wheat and barley were first domesticated.
- (b) Market gardening and dairying, which produce perishable, high-value goods that must reach the market quickly.
- (c) Irrigation without drainage causes salinisation: water evaporates and leaves salt in the soil, which lowers yields, as in the cotton fields of the Aral Sea basin.

Common errors

- Mixing up the two scales: intensive/extensive is about inputs per hectare, subsistence/commercial is about purpose.
- Putting forest in the outer ring of von Thünen: in his model it was the second ring.
- Applying von Thünen today without saying how refrigeration and air freight change it.
- Saying the Green Revolution had only benefits.
- Confusing salinisation with eutrophication.
- Naming a land survey system without a place where it was used.

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Key terms

intensive agriculture: Farming with large inputs of labour or capital per unit of land.

shifting cultivation: Clearing a plot, farming it for a few years, then moving on and letting it recover.

agricultural hearth: A place where plants or animals were first domesticated.

Green Revolution: The spread of high-yield seeds, fertiliser and irrigation from the 1960s.

bid-rent: The idea that land users pay more for land closer to a market.

commodity chain: The steps that link a raw product to the final consumer.

salinisation: The build-up of salt in soil, often caused by irrigation.

food desert: An area where fresh, affordable food is hard to buy.

Check yourself

- Classify cattle ranching in Australia using both scales.
- Why did French settlers divide land into long lots?
- Give one benefit and one cost of the Green Revolution.

Answers: Extensive and commercial. So that every farm had access to the river for transport and water. Benefit: much higher yields (India's wheat harvest rose from about 12 to 20 million tonnes, 1965–1970); cost: falling groundwater, fertiliser pollution, or gains going mainly to richer farmers.

Sources for this lesson

College Board, *AP Human Geography Course and Exam Description*, Unit 5, topics 5.1–5.12 (`syllabi/ap/ap_human_geography_CED.pdf`). Women farmers: FAO, *The State of Food and Agriculture 2010–11*. The practice questions are written for this course, not taken from past papers.

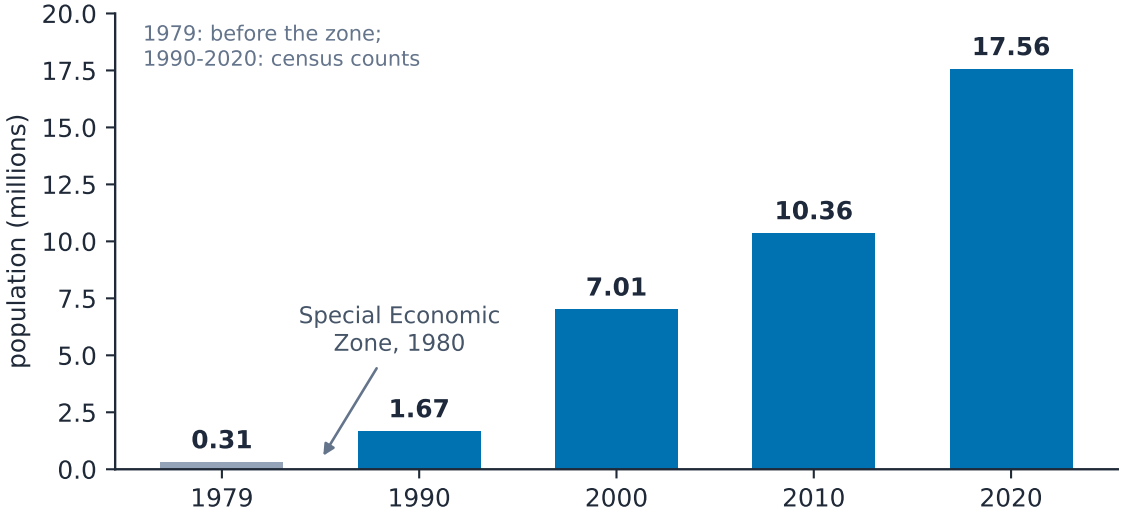
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Cities and Urban Land-Use Patterns and Processes

AP Human Geography

Origin and Growth of Cities

In 1980 China made Shenzhen, a recently established city in a largely rural area next to Hong Kong, one of its first **Special Economic Zones** 经济特区. About 300,000 people lived there. Factories came for the low costs and the closeness to Hong Kong's port and banks; millions of workers came from the countryside for the jobs. The 2020 census counted 17.56 million people in Shenzhen. Its site had not changed; its situation, as the gate between China and the world economy, changed everything.

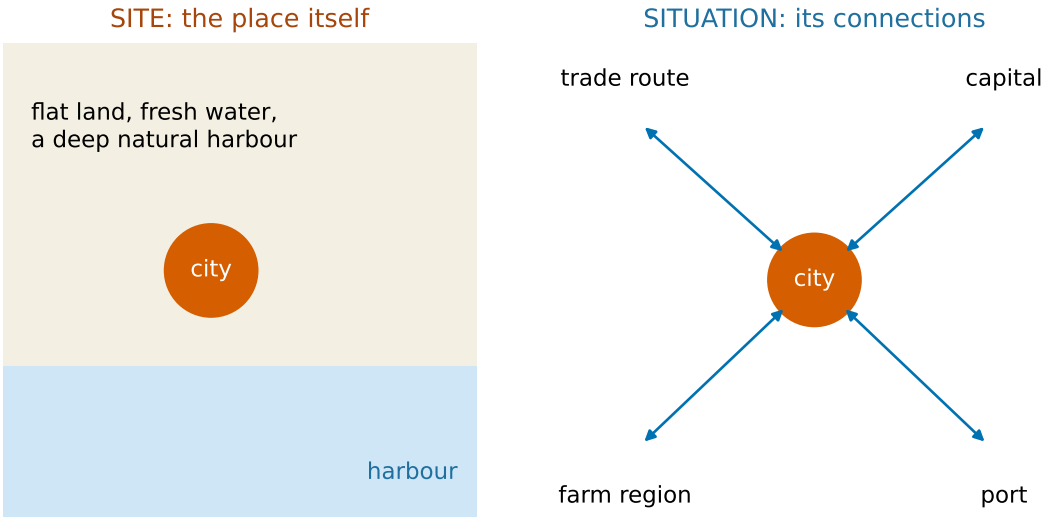


Forty years from a border county to a megacity: growth driven by situation and rural-to-urban migration.

Urbanization 城市化 is the growth in the share of people living in cities. It began with the agricultural surplus that freed some people from farming, and accelerated with the Industrial Revolution.

- Urban shares are rising in many lower-income countries. Urban population growth can reflect rural-to-urban migration, natural increase and reclassification of settlements; their contributions vary by place.
- A **suburb** 郊区 is a residential area on the edge of a city; **suburbanization** 郊区化 and **sprawl** 城市蔓延 spread cities outward.
- **Site** 地点 (the physical features of a place) and **situation** 区位 (its location relative to other places) explain why a city grew where it did.

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Site is the place itself; situation is its connections to other places

> **Worked example: Shanghai.** Its **site** is flat, low land on the Huangpu River, which gave a sheltered harbour. Its **situation** is at the mouth of the Yangtze, China's longest river, so goods from a huge inland region pass through it to the sea. The situation explains why Shanghai became China's biggest port and trading city; the site explains the problems too, such as flooding and soft ground for tall buildings.

Cities and Globalization

Some cities have influence far beyond their own country.

- **World cities** 世界城市 (also called **global cities**) – such as New York, London, and Tokyo – are command centres of the global economy, finance, and culture.
- Globalization links cities into networks; a decision in one world city can affect jobs on the other side of the planet.

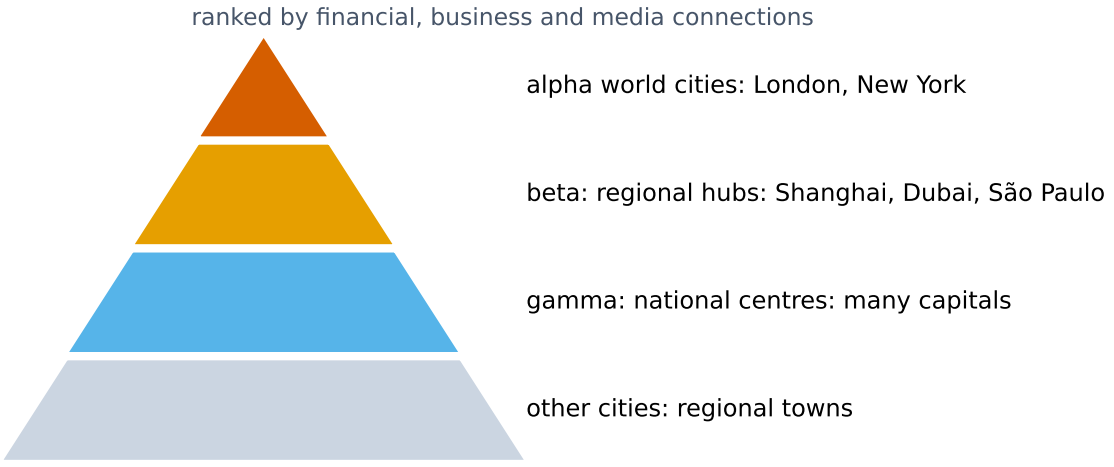
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The Manhattan skyline in New York, a world city: its banks and company headquarters help run the global economy



Shibuya Crossing: world cities concentrate people, infrastructure and global connections



The hierarchy of world cities

The Distribution of Cities

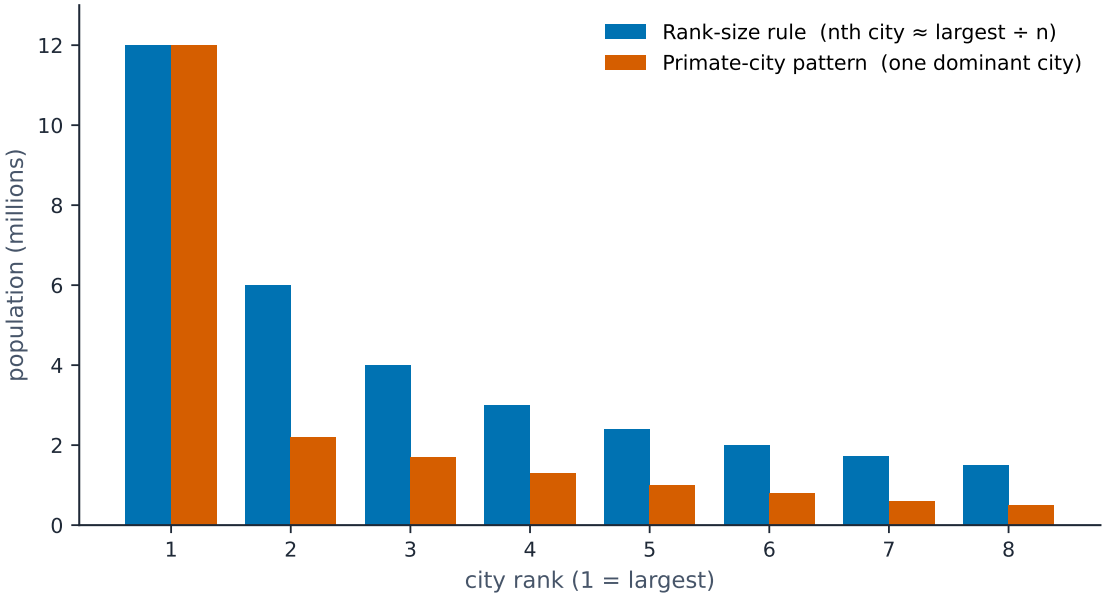
Cities within a country follow patterns of size and spacing.

- The **rank-size rule** 位序规模法则 says the nth-largest city is 1/n the size of the largest (the 2nd city is half the largest, the 3rd a third, and so on).
- A **primate city** 首位城市 is far larger than all others (Paris, Bangkok), dominating its country.
- **Central place theory** 中心地理论 (Christaller) explains the spacing of settlements: larger centres are fewer and farther apart and offer higher-order goods; their **market area** is the surrounding region they serve.

Two more words explain why. The **threshold** 门槛 is the smallest number of customers a shop or service needs to stay open; the **range** 服务范围 is the farthest distance people will travel to use it. A small food shop has a low threshold and a short range, so it can serve a small settlement if enough customers are within reach. A specialist hospital or a major football stadium can have a high threshold and a long range, drawing people from a wide market area. The relevant population is the accessible market area, not just the settlement itself.

Worked example: where can it open? A region has 60 villages of 1,000 people, 6 towns of 20,000 and one city of 200,000. A bakery needs 2,000 customers and a heart hospital needs 300,000. For this example, assume all residents are potential customers, the city can draw the whole region within the hospital's range, and no town or village can reach a market area of 300,000. The bakery can open in every town and the city, and in a village only if it can draw customers from a neighbouring village too. The heart hospital's threshold is bigger than any single place, so it must go in the city, which is the only place where its market area (city, towns and villages together: 380,000 people) reaches the threshold. That is the pattern of central place theory: many small centres with low-order goods, a few large ones with high-order goods.

Worked example: the rank-size rule. A country's largest city has 12 million people. The rule predicts the 2nd city at $12 \div 2 = 6$ million, the 3rd at $12 \div 3 = 4$ million and the 4th at $12 \div 4 = 3$ million. If the real 2nd city has only 1.5 million, the largest city is eight times bigger than it, not twice: that is a primate pattern, like Thailand, where Bangkok is far bigger than any other city.



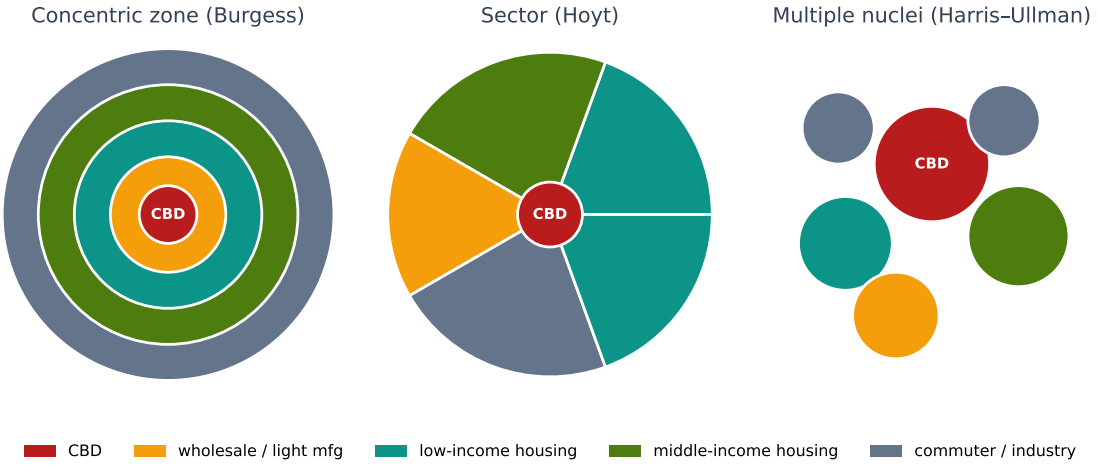
Under the rank-size rule the nth city is about 1/n the size of the largest; a primate pattern has one dominant city far bigger than the rest

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Worked example (a real AP exam question). *"Compare the concept of a metacity with the concept of a world city."* (2024) A full-mark answer: *"A metacity is defined by size – a continuous urban area of more than 20 million people – while a world city is defined by influence, acting as a command centre for the global economy. A city such as Tokyo can be both, but a large metacity in a poorer country may not be a world city."* The command word **Compare** needs an explicit point of difference (size versus influence), not two separate definitions sitting side by side.

The Internal Structure of Cities

Three classic models describe how North American cities are arranged inside.



The concentric-zone, sector, and multiple-nuclei models each explain city land use differently

- **Concentric zone model** 同心圆模型 (Burgess) – rings around the **Central Business District (CBD)** 中央商务区, from inner-city to commuter suburbs.
- **Sector model** 扇形模型 (Hoyt) – land use grows outward in wedges along transport routes.
- **Multiple nuclei model** 多核心模型 (Harris–Ullman) – the city has several centres (nodes), not just one CBD, as it grows and specialises.

Later models explain other kinds of city:

Model	Main idea	Where it fits
peripheral model 边缘模型 (Harris)	a central city surrounded by suburbs and **edge cities** 边缘城市 (office and shopping centres), joined by a ring road	US cities built around the car, such as Atlanta or Houston
Latin American (Griffin–Ford)	a commercial **spine** of wealth from the CBD, with rings that get poorer outward and informal settlements at the edge	Mexico City, Lima, Rio de Janeiro
African (de Blij)	three CBDs (colonial, traditional, market) and mining or factory zones	Nairobi, Lagos
Southeast Asian (McGee)	the old colonial port as the centre, a Western business zone and a Chinese commercial zone, with mixed farming and urban land at the edge	Jakarta, Bangkok

Worked example: which model fits? A description reads: *"The richest homes run in a long strip from the old centre along the main boulevard, next to the best shops. Further from the centre, housing gets poorer, and on the steep hills at the edge people have built their own homes without services."* Match the clues to a model. A wealthy strip from the CBD is the **spine**; zones that get poorer outward, and self-built housing at the edge, are the rings and the **informal settlements** of the **Latin American (Griffin–Ford) model**. The combination fits Griffin–Ford more closely than the sector model. Hoyt's model has both high- and low-income sectors extending outward; it does not require every outer neighbourhood to be wealthy. A wedge alone cannot distinguish the models. Name the model, quote two clues, and explain why their combination supports this model over the nearest alternative.

Density, Land Use, and Infrastructure

Inside the city, land use and density change from centre to edge.

- High central land prices can encourage dense development through **bid-rent** competition. Building density and residential population density differ: a CBD full of offices may have few residents, and density can peak elsewhere.
- **Zoning** 分区规划 laws separate land uses (residential, commercial, industrial).
- **Infrastructure** 基础设施 – roads, water, power, transit – must grow with the city; where it lags, **informal settlements** 非正规住区 (housing outside formal planning or tenure systems; not all informal settlements are slums) may form.

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- **Residential density** has three broad types: low (detached houses with gardens, mostly in suburbs), medium (row houses and small apartment blocks) and high (tall apartment towers, usually near the centre or along transit lines).



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

Urban Sustainability and Data

Planners use **data** and design to make cities work better.

- **Smart-growth** 精明增长, **mixed-use** development, and **transit-oriented** design fight sprawl and car dependence.
- **Greenbelts** 绿带 limit outward growth; **urban renewal** 城市更新 rebuilds decayed areas, but can cause **gentrification** 中产阶级化 that displaces poorer residents.
- Census and geospatial **data** guide where to put schools, transit, and services.
- **Quantitative data** 定量数据 are numbers (census counts, rents, traffic counts); **qualitative data** 定性数据 are words and images (interviews with residents, photos, field notes). Planners need both: numbers show *how many* people a change affects, interviews show *how* it affects them.

Challenges of Urban Changes and Sustainability

Rapid urban growth brings problems:

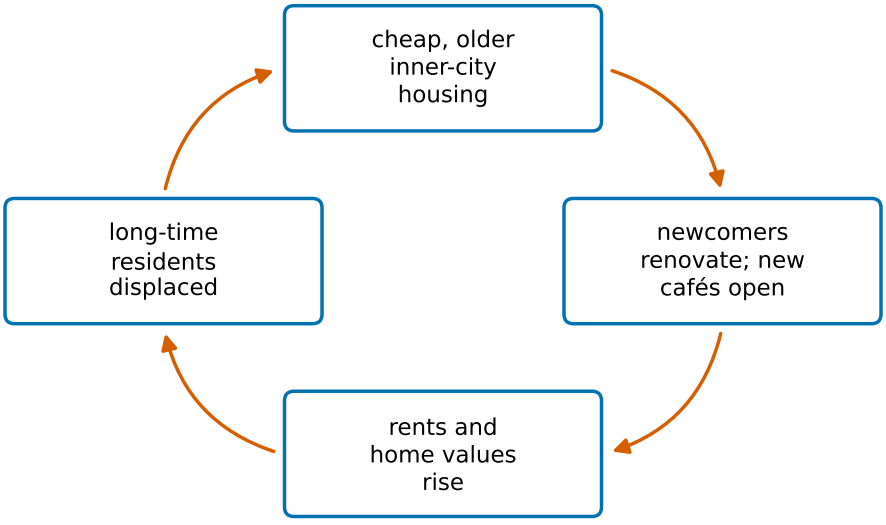
- **Social**: housing shortages, segregation, and the displacement caused by gentrification.

Process	What happened	Effect
redlining 红线政策	from the 1930s, US government-backed lending systems and residential-security maps discriminated against Black neighbourhoods; maps also classified other areas as "hazardous"	restricted access to mortgages contributed to disinvestment; the maps were part of a wider discriminatory system
blockbusting	estate agents scared white owners into selling cheaply by saying minorities were moving in, then sold the houses at higher prices	fast neighbourhood change and white flight to the suburbs
filtering	existing housing becomes available to lower-income households as higher-income households move to newer housing	can increase access to lower-cost housing; subdivision and physical decline are possible, not required
gentrification	higher-income residents and investment enter a lower-income area	rents may rise and long-term residents may be displaced; outcomes vary

- **Environmental**: air and water pollution, the **urban heat island** 城市热岛 effect, waste, and heavy resource use. **Brownfields** 棕地 are properties whose reuse may be complicated by actual or potential contamination; they are not limited to old factories. Assessment establishes whether cleanup is needed for the proposed use.
- **Economic**: strained budgets, congestion, and the cost of extending infrastructure to sprawling edges.

Sustainable cities try to grow **up** rather than **out**, invest in public transit, and mix homes with jobs and services.

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The gentrification cycle

Worked example: a free-response question

Free-response parts are scaffolded by their command verbs. **Identify** needs a term or example; **describe** needs its features; **explain** shows how or why, supported by evidence or reasoning. Give a specific example when the prompt asks for one.

Answer (a), (b) and (c).

(a) Identify ONE factor that makes a city a world (global) city.

(b) Describe the concentric zone model of urban structure.

(c) Explain ONE effect of suburbanisation on a city.

Model answer.

- (a) Headquarters of transnational corporations and major financial markets, as in London or New York.
- (b) The city forms rings around a central business district, from a zone of transition and working-class housing outward to higher-income residential zones and commuters.
- (c) As people and businesses move to the suburbs, the central city can lose tax revenue, which reduces money for services such as schools and public transport.

Exam tips

- Separate a city's **site** (physical setting) from its **situation** (position relative to others).
- Apply the **rank-size rule** (the nth city is about 1/n of the largest) and spot a **primate city**.

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- Match a city description to the right model: **concentric zone**, **sector**, or **multiple nuclei**.
- Link **land value** to density – costly central land is used by building upward.
- Discuss change with **suburbanization**, **sprawl**, and **gentrification**, and **smart-growth** responses.

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Industrial and Economic Development Patterns and Processes

AP Human Geography

The Industrial Revolution

In 1913 Henry Ford's factory at Highland Park, Michigan, started a moving assembly line. The time to build the chassis of a Model T fell from about twelve hours to about an hour and a half, and the car became cheap enough for Ford's own workers to buy. Unit 7 asks where industry locates, how we measure development, why some countries are richer than others, and how trade has rearranged work around the world.

In this unit you will:

- Explain how the **Industrial Revolution** 工业革命 spread and changed where people work.
- Classify jobs into **economic sectors** 经济部门 and explain where industry locates.
- Use measures of **development** 发展, and explain the role of women in development.
- Apply theories of development: Rostow, Wallerstein and dependency theory.
- Explain how trade and **globalisation** 全球化 have shifted industry, and what **sustainable development** 可持续发展 means.

Industrialisation began in Britain in the late 1700s, where coal, iron, capital and workers were close together. It spread to Western Europe, the United States and Japan in the 1800s. Industrial countries needed raw materials and markets, which drove colonialism, and factory jobs drew people from farms into cities such as Manchester and Chicago.

Industry still clusters at **break-of-bulk points** 转运点, where cargo changes from one kind of transport to another, such as ship to rail. Moving goods costs money, so factories that process imports often locate right at the port.

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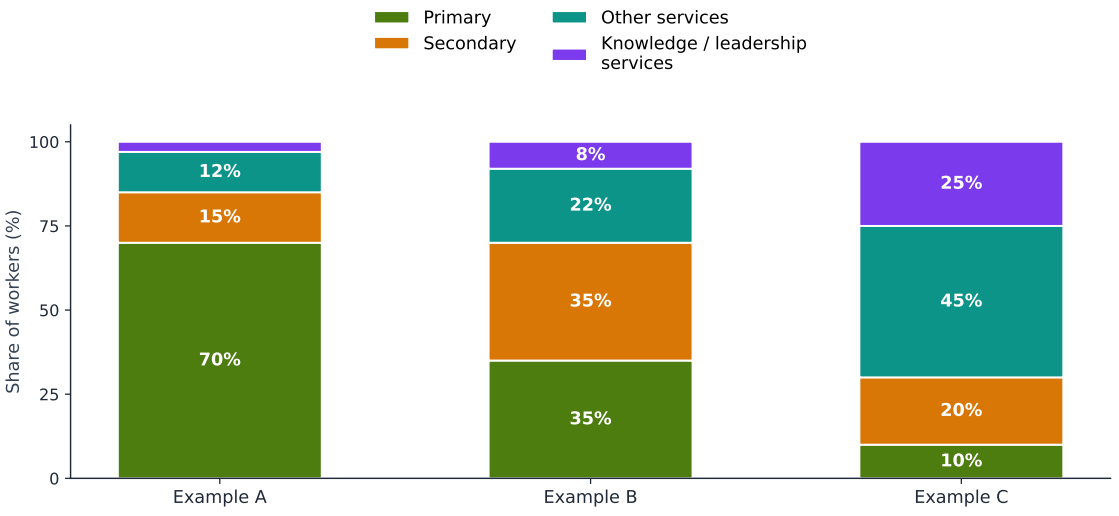


The ports of Los Angeles and Long Beach are a break-of-bulk point: cargo moves from ship to rail and truck

Economic Sectors and Patterns

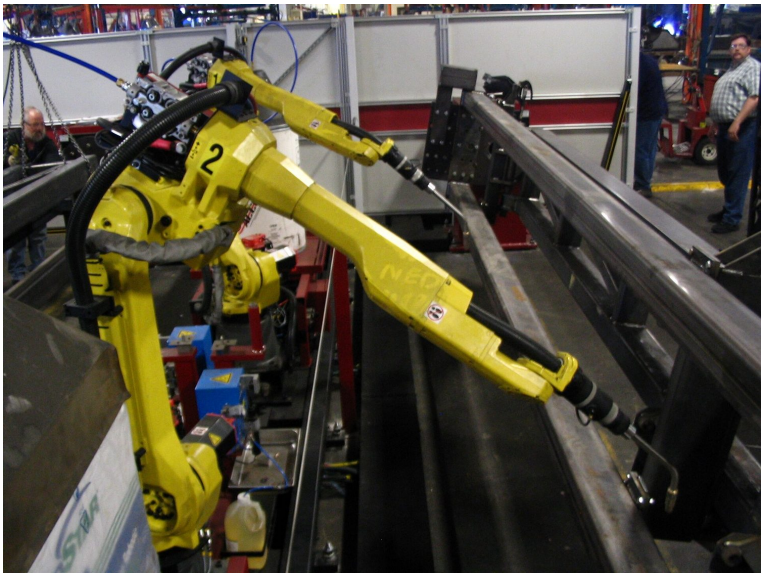
Geographers divide work into five sectors.

Sector	What workers do	Examples
Primary sector 第一产业	Take raw materials from the earth	Farming, fishing, mining, forestry
Secondary sector 第二产业	Make goods	Car factories, steel mills, food processing
Tertiary sector 第三产业	Provide services	Shops, transport, health care, teaching
Quaternary sector 第四产业	Work with information	Research, finance, software
Quinary sector 第五产业	Make top-level decisions	Company directors, senior government officials



Three example economies: as the primary share falls, the secondary and then the service shares rise

As a country develops, the share of workers in the primary sector usually falls, the secondary share rises and then falls, and services grow. The robots in modern car plants show why: factories can make more goods with fewer workers.



Welding robots in a car factory: automation lets output grow while the number of factory jobs falls

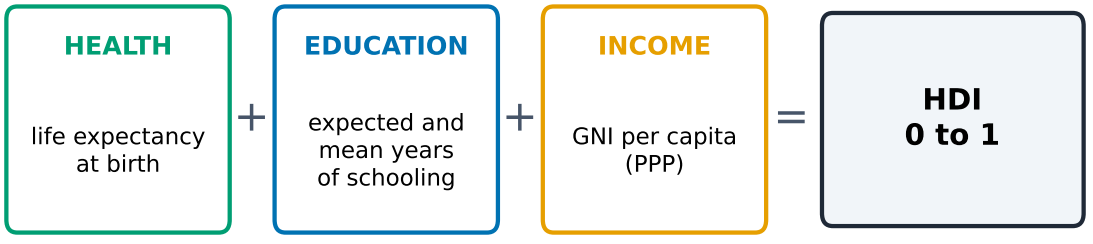
Weber's least-cost theory 韦伯最小成本理论 (Alfred Weber, 1909) says a factory locates where its total costs are lowest. It considers three costs.

- **Transport:** a **bulk-reducing** 减重 industry, such as copper smelting, loses weight in processing, so it locates near the raw material. A **bulk-gaining** 增重 industry, such as soft-drink bottling, gains weight (it adds water), so it locates near the market.
- **Labour:** cheap labour can attract a factory even if transport costs more.
- **Agglomeration** 集聚: factories that cluster share suppliers, skilled workers and roads, which lowers costs. Silicon Valley is an example.

Measures of Development

Development means improvement in people's economic and social well-being. No single number measures it, so geographers use several.

- **Gross Domestic Product (GDP) per capita** 人均国内生产总值: the value of everything produced in a country in a year, divided by its population.
- **Gross National Income (GNI)** 国民总收入 **per capita**: like GDP, but it adds income residents earn abroad and subtracts income sent abroad.
- The **Human Development Index (HDI)** 人类发展指数: combines life expectancy, years of schooling and GNI per capita into one value from 0 to 1. In the UN's 2023/24 report Switzerland scored 0.967 and Somalia 0.380.
- The **Gender Inequality Index (GII)** 性别不平等指数: measures inequality between women and men in health, empowerment and work; a lower score means more equality.
- The **Gini coefficient** 基尼系数: measures how unequally income is shared, from 0 (everyone equal) to 1 (one person has everything).



GDP alone misses health and schooling; the GII adds gender inequality

The Human Development Index combines health, education and income

Averages can hide inequality. Four households earning 10, 10, 10 and 70 thousand dollars average 25 thousand, exactly the same as four households earning 25 thousand each, but the first group is far more unequal. That is why GDP per capita should be

read with the Gini coefficient.

Other useful indicators are literacy, **infant mortality** 婴儿死亡率, fertility rate and the share of workers in each sector. Many people in poorer countries work in the **informal economy** 非正规经济, such as street selling, which is not taxed or fully counted in GDP.

Women and Economic Development

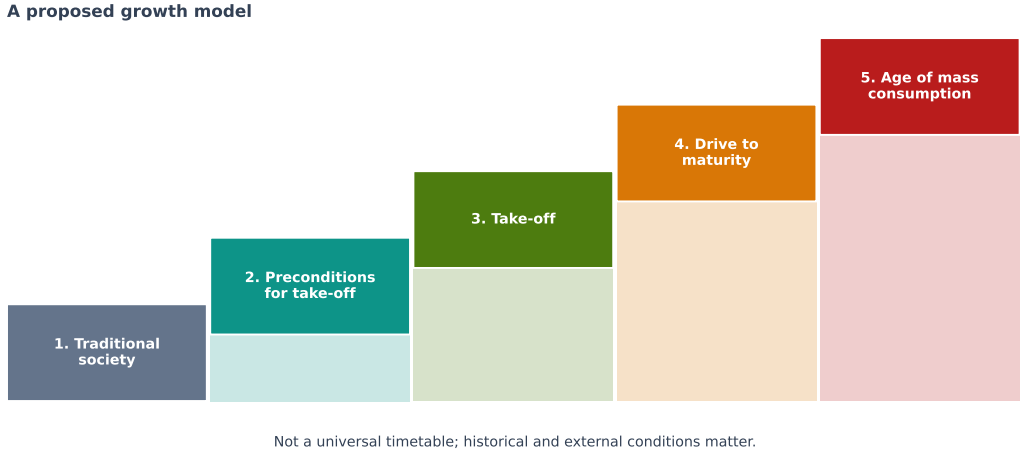
When women can study and work for wages, families have more income and usually fewer, healthier children. But women still face barriers: in most countries they earn less than men for similar work, and they do most unpaid care work.

Microfinance 小额信贷 gives small loans to people too poor to borrow from banks. Muhammad Yunus founded the Grameen Bank in Bangladesh in 1983 to lend mainly to women, and he and the bank won the Nobel Peace Prize in 2006. A small loan can start a business, but it must be repaid.

A woman's stall earns 180 dollars a week in sales; she pays 100 dollars for stock and costs, and 50 dollars a week on her loan. She keeps $180 - 100 - 50 = 30$ dollars. If sales fall to 140 dollars, she is left with $140 - 100 - 50 = -10$ dollars, and the loan becomes a debt problem. Microfinance works best when the business has steady demand.

Theories of Development

Rostow's stages of growth 罗斯托发展阶段 (Walt Rostow, 1960) say every country passes through five stages: traditional society, preconditions for take-off, take-off, drive to maturity and high mass consumption. Countries develop by investing and industrialising. Critics say the model is based on Western Europe and the United States, and ignores the effects of colonialism and trade.



Rostow's five stages, from traditional society to high mass consumption

Wallerstein's world-systems theory 沃勒斯坦世界体系理论 (Immanuel Wallerstein, 1974) sees one world economy with three groups of countries:

- The **core** 核心 (the United States, Western Europe, Japan): high-value manufacturing and services, wealth and power.
- The **periphery** 边缘 (much of sub-Saharan Africa): raw materials and low-wage work.
- The **semi-periphery** 半边缘 (China, India, Brazil, Mexico): a mix of both, and the place where countries can move up.

Dependency theory 依附理论 argues that poor countries stay poor because colonialism made them export raw materials to rich countries. Zambia, for example, depends on copper for most of its exports, so a fall in the copper price hits its whole economy.

Trade and the World Economy

Countries trade because of **complementarity** 互补性 (one place has what another needs) and **comparative advantage** 比较优势, which means a lower **opportunity cost** 机会成本.

Suppose in one day country A can make 10 units of grain or 5 of cloth, and country B can make 6 of grain or 4 of cloth. A is better at both (absolute advantage). But for one unit of grain A gives up $5 \div 10 = 0.5$ cloth, while B gives up $4 \div 6 \approx 0.67$ cloth. So A should make grain. For one unit of cloth A gives up $10 \div 5 = 2$ grain, while B gives up only $6 \div 4 = 1.5$ grain, so B should make cloth. Both gain by trading.

Trade is organised by institutions and agreements:

- The **World Trade Organization** 世界贸易组织 (WTO, 1995) sets rules for trade between its members.
- **Trade blocs** such as the European Union and Mercosur (1991, South America) cut **tariffs** 关税, taxes on imports, between members.
- OPEC (1960) is a group of oil-exporting countries that tries to control oil supply and prices.
- The International Monetary Fund and the World Bank lend to countries, often on condition that they open their markets.

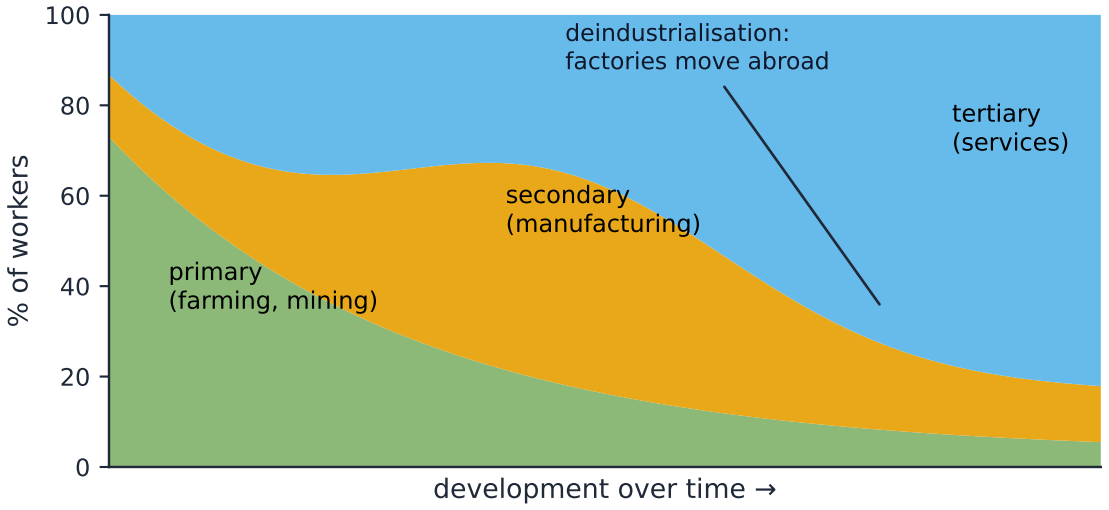
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Container shipping cut the cost of moving goods and made global supply chains possible

Globalisation has moved factories (topic 7.7).

- **Outsourcing** 外包 and **offshoring**: companies moved manufacturing to countries with lower wages, such as China, Vietnam and Mexico.
- **Deindustrialisation** 去工业化: factory jobs fell in core countries. Detroit's population fell from about 1.85 million in 1950 to about 640,000 in 2020 as car plants closed.
- **Special economic zones** 经济特区 attract foreign firms with low taxes and fewer rules: Shenzhen in China (1980), or the **maquiladoras** 客户工厂 along Mexico's border with the United States.
- **Post-Fordist production** 后福特主义生产: flexible factories and **just-in-time delivery** 准时生产, pioneered by Toyota, keep little stock, which saves money but makes supply chains easy to disrupt.



As economies develop, workers move from primary to secondary to tertiary jobs; deindustrialisation follows when factories move abroad

Sustainable Development

The Brundtland Report (1987) defined sustainable development as meeting "the needs of the present without compromising the ability of future generations to meet their own needs". In 2015 the UN adopted 17 **Sustainable Development Goals** 可持续发展目标, such as ending poverty, clean water and climate action, to reach by 2030.

- **Ecotourism** 生态旅游: Costa Rica protects about a quarter of its land in national parks and reserves, and tourism pays for much of it; but too many visitors can damage the places they come to see.
- **Renewable energy:** solar and wind power can supply electricity without the emissions of coal.
- An **ecological footprint** 生态足迹 measures how much land and water a person or country needs to supply what it uses and absorb its waste.

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Solar panels in Spain: renewable energy is one path to sustainable development

Worked example: choosing a factory site

A firm compares two sites. Daily costs in dollars:

Site	Transport	Labour	Agglomeration savings
R (near the raw material)	90	70	10
M (near the market, in a city)	50	110	20

Step 1: total cost = transport + labour − savings. R: $90 + 70 - 10 = 150$ dollars a day. M: $50 + 110 - 20 = 140$ dollars a day.

Step 2: apply Weber. M is cheaper by 10 dollars a day, even though its labour costs more, because it saves on transport and gains more from clustering.

Step 3: explain. This fits a bulk-gaining industry: the finished product is heavier than its inputs, so locating near the market reduces transport costs.

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Worked example: a free-response question

Free-response parts use command verbs. **Identify** needs a term or example; **describe** needs its features; **explain** shows how or why.

(a) Identify the economic sector that includes manufacturing.

(b) Describe ONE measure of development other than GDP per capita.

(c) Explain ONE way deindustrialisation has affected cities in core countries.

Model answer.

- (a) The secondary sector.
- (b) The Human Development Index combines life expectancy, years of schooling and income per person into one value from 0 to 1.
- (c) When factories moved abroad, cities such as Detroit lost manufacturing jobs; unemployed workers spent less and many moved away, so the city's population and tax income fell.

Common errors

- Putting services such as teaching in the quaternary sector: teaching is tertiary; research is quaternary.
- Reading GDP per capita as each person's income: it is an average.
- Saying HDI is income only: it also includes health and education.
- Describing Rostow without a criticism, or Wallerstein without naming core, periphery and semi-periphery.
- Mixing up absolute and comparative advantage.
- In Weber questions, forgetting to say whether the industry is bulk-reducing or bulk-gaining.

Key terms

break-of-bulk point: A place where cargo changes from one form of transport to another.

agglomeration: The clustering of firms, which lets them share suppliers, workers and services.

Human Development Index: A measure combining life expectancy, education and income.

informal economy: Economic activity that is not taxed or regulated by the government.

microfinance: Small loans to people who cannot borrow from banks.

comparative advantage: The ability to produce a good at a lower opportunity cost than another producer.

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deindustrialisation: The decline of manufacturing employment in a place.

sustainable development: Development that meets present needs without harming future generations.

Check yourself

- Is a soft-drink bottling plant bulk-gaining or bulk-reducing? Where should it locate?
- Two countries have the same GDP per capita. Why might their HDI differ?
- Name one place where special economic zones attracted foreign factories.

Answers: Bulk-gaining (it adds water), so near the market. HDI also includes life expectancy and schooling, so a country with better health and education scores higher. Shenzhen, China (or the maquiladoras on Mexico's US border).

Sources for this lesson

College Board, *AP Human Geography Course and Exam Description*, Unit 7, topics 7.1–7.8. HDI values: UNDP, *Human Development Report 2023/2024*. The practice questions are written for this course, not taken from past papers.

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