Course Companion

International Baccalaureate · IB Diploma · Geography · SL

Every topic handout in one volume

exercises.lol

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Changing population (core: population distribution - changing population)

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Changing population

IB Diploma Programme Geography SL (first assessment 2019; 2017 guide). The core is shared by SL and HL, and this topic covers its first unit in full – *Population distribution–changing population* – from the measures of population change (crude birth and death rates, natural increase) through the demographic transition model and population structure to migration, ageing and youthful populations, and population policy. The geographic concepts (POWER, PROCESS, POSSIBILITY, SCALE, SPATIAL INTERACTIONS) frame every answer, and the worked numbers below are original and reconciled.

Must-know for the changing-population unit:

Family	Content
measures	CBR, CDR per 1 000; NIR = CBR − CDR; doubling time ≈ 70/NIR%
distribution	physical, economic, historical and political factors; density
transition	DTM stages 1–5 with CBR/CDR trajectories
structure	pyramids: expansive, stationary, constrictive; dependency ratio
migration	push/pull, barriers, refugees and IDPs, remittances
policy	pro- and anti-natalist; ageing vs youthful case logic

Population distribution and measures

Population distribution answers WHERE people live and WHY: the physical frame (climate, water, relief, soils), the economic frame (jobs, trade routes, cities), and history and politics (colonisation, conflict, policy). Distribution is described by DENSITY – arithmetic density = population ÷ area; physiological density = population ÷ arable area, exposing pressure on farmland. Sparse and dense are relative, and the WHY questions carry the marks: altitude and aridity thin populations; industry and coastlines thicken them.

The MEASURES of change: the **crude birth rate** (CBR) is live births per 1 000 people per year; the **crude death rate** (CDR) is deaths per 1 000 per year; **natural increase** is their difference – a country with CBR 18 and CDR 9 has NIR = 18 − 9 = 9 per 1 000 = 0.9% a year, and a doubling time of about 70/0.9 ≈ 78 years (the rule of 70). TOTAL population change adds NET

MIGRATION to natural increase: growth is births minus deaths plus incomers minus outgoers.

Population change: transition, structure and policy

The **demographic transition model** (DTM) traces countries through five stages. Stage 1: high CBR and CDR, low growth (no country remains). Stage 2: death rates fall (medicine, sanitation) while births stay high – explosive growth, the classic LEDC profile. Stage 3: birth rates fall (education, urbanisation, women's work) – growth slows. Stage 4: both low, growth near zero – most MEDCs. Stage 5: births below replacement (CBR below CDR) – decline, as in Japan and Germany. The model's limits: it generalises from Europe's path, undervalues migration, and dates – but as a frame for comparing countries it remains the exam's workhorse.

POPULATION STRUCTURE is read from the **population pyramid** : an EXPANSIVE pyramid (wide base) means high fertility and a youthful population (Nigeria-shape); a STATIONARY pyramid means near-replacement growth; a CONSTRICTIVE pyramid (narrow base, wide top) means ageing and decline (Japan-shape). The **dependency ratio** summarises the load: dependents (0–14 plus 65+) over the working group (15–64), times 100 – with 60 children, 30 elderly and 210 workers the ratio is $90/210 \times 100 \approx 43$ per 100. AGEING populations strain pensions and health care while labour shortens; YOUTHFUL populations strain schooling and jobs while promising a future demographic dividend; the two cases are evaluated, not just described.

POPULATION POLICY answers both: **pro-natalist policy** (France's childcare, leave and cash support) raises fertility in ageing societies; anti-natalist policy (China's one-child era, 1979 to 2015) lowered fertility at the price of an ageing population and a skewed sex ratio; some countries now pursue population-neutral policies on health, education and women's employment, letting fertility follow.

Migration and its impacts

Migration is a move crossing a boundary for more than a year: INTERNAL (rural to urban) or INTERNATIONAL, voluntary or forced. The explanations are **push factors** driving people out (unemployment, conflict, disaster, land shortage) and PULL factors drawing them in (jobs, safety, family, services), moderated by BARRIERS (cost, distance, borders, language) – Lee's model adds intervening obstacles and personal factors to the two lists. FORCED migrants who cross a border are **refugees** (1951 Convention: well-founded fear of persecution); those displaced within their state are IDPs; economic migrants move by choice and fall outside the Convention. IMPACTS flow both ways: origin communities lose the young and gain remittances (money sent home, a major GDP line for Nepal and the Philippines), relieve unemployment and receive return migration's skills; destinations gain labour and youth, and absorb integration costs and social strain. Internal migration drives

urbanisation and, at scale, MEGACITY growth – the process the urban-environments option takes up.

> **Worked example.** A district of 2 million with CBR 24 and CDR 8 grows by natural increase of 16 per 1 000 a year; net out-migration of 12 per 1 000 (young adults leaving for the coast) leaves total growth near 4 per 1 000 – a population ageing even as it grows slowly, the exact profile that switches policy debate from jobs to elder care.

Checklist

- Distribution factors physical, economic, historical, political; arithmetic vs physiological density (distribution).
- CBR/CDR per 1 000; NIR = CBR − CDR (18 − 9 → 0.9%); doubling time ≈ 70/NIR (≈78 years); add net migration for total change (measures).
- DTM stages 1–5 with the CBR/CDR logic of each, and two limitations of the model (transition).
- Pyramid shapes (expansive, stationary, constrictive) with country profiles; dependency ratio 90/210 ≈ 43; ageing vs youthful strain evaluated both ways (structure).
- Pro-natalist (France), anti-natalist (China 1979–2015) and neutral policies with their trade-offs (policy).
- Push/pull/barriers (Lee); refugees vs IDPs vs economic migrants (1951 Convention); remittances and the two-sided impacts; internal migration → urbanisation (migration).

Boundary notes: the SL core paper rewards command-term precision – "explain" needs a because-chain, "examine" needs strengths and limits; data-response items calculate NIR, doubling time and dependency ratios from given figures. All worked numbers are original and reconciled.

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

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Climate and resources

IB Diploma Programme Geography SL (first assessment 2019; 2017 guide). The core is shared by SL and HL, and this topic covers its second and third units in full – *Global climate–vulnerability and resilience* (climate change and its causes, vulnerability, adaptation and mitigation) and *Global resource consumption and security* (patterns of consumption, renewable and non-renewable resources, food and water security, stewardship). The concepts SUSTAINABILITY, PROCESS and SCALE carry the answers, and the worked figures below are the stable published ones.

Must-know for climate and resources:

Family	Content
climate	natural vs anthropogenic causes; evidence: temperature, ice cores, sea level
thresholds	Paris Agreement: hold warming well below 2°C, pursuing 1.5°C
response	MITIGATION removes causes; ADAPTATION adjusts to impacts
footprint	ecological footprint ≈ 2.6 gha/person vs biocapacity ≈ 1.6 → about 1.7 Earths
resources	renewable vs non-renewable; agriculture ≈ 70% of freshwater withdrawals
security	food: availability, access, utilisation, stability; stewardship over consumerism

Global climate: change, vulnerability and resilience

CLIMATE CHANGE has NATURAL causes – orbital (Milankovitch) cycles, solar variability, volcanic episodes – and ANTHROPOGENIC ones: the **greenhouse effect** intensified by carbon dioxide from fossil-fuel burning and land-use change, and methane from livestock, rice and leaks. The EVIDENCE triangulates: instrument records show about 1°C of warming since pre-industrial times; ice cores extend the carbon-dioxide record back 800 000 years; glaciers retreat and global sea level rises. The PARIS AGREEMENT (2015) frames the target: hold warming WELL BELOW 2°C while pursuing 1.5°C – the number every strategy answer measures itself against.

Vulnerability is exposure plus sensitivity minus capacity: low-lying deltas

and small island states face sea-level rise; arid margins face drought; poverty, weak governance and dependence on agriculture raise sensitivity; wealth and institutions lower it. **Resilience** is the capacity to absorb shocks and reorganise – Bangladesh's cyclone shelters and warning systems turned a death toll of hundreds of thousands (1970) into tens (2020s): the same hazard, transformed capacity. The response pair is the exam's spine: **mitigation** attacks the CAUSE (decarbonising energy, reforestation, efficiency, carbon pricing), while **adaptation** adjusts to the IMPACT (sea walls, drought-resistant crops, managed retreat, early warning). Richer states can fund both; poorer states are most vulnerable and least resourced – the justice frame the essays want.

Resource consumption and security

Global consumption patterns are UNEVEN and RISING: energy use per person in high-income states runs several times the low-income figure, and total demand grows with population and industrialisation. The **ecological footprint** measures demand on nature in global hectares per person: the world average of about 2.6 gha against a biocapacity of about 1.6 gha means humanity uses the equivalent of roughly 1.7 Earths – overshoot that is only possible by drawing down natural capital. RESOURCES divide into **renewable resources** (solar, wind, biomass, fish – restorable within human timescales when harvested within their regeneration rate: the sustainable yield) and non-renewable (coal, oil, gas, minerals – stock, not flow). Energy transitions shift the mix from fossil toward renewables, judged on cost, storage, land use and the minerals the transition itself mines.

WATER: agriculture takes roughly 70% of global freshwater withdrawals, industry and municipalities the rest; **water security** fails where demand crosses supply – aquifer depletion, glacier-fed rivers losing their store, and pollution – and is measured by access to safe water, not raw availability. FOOD: **food security** stands on four pillars – AVAILABILITY (production and imports), ACCESS (affordability and distribution), UTILISATION (nutrition and safety) and STABILITY (across seasons and shocks) – so a famine can occur amid availability where access collapses. The strategic choice the unit ends on: CONSUMERISM (consume more, secure supply) versus **resource stewardship** (consume differently – efficiency, circular economies, demand management, the SDG logic of using less to live well), with the ecological-footprint arithmetic as the scoreboard.

Checklist

- Natural vs anthropogenic climate causes; the three evidence streams; the 2°C/1.5°C Paris frame (climate).
- Vulnerability as exposure + sensitivity − capacity; resilience with the Bangladesh contrast; mitigation vs adaptation with named examples of each (climate).

- Footprint vs biocapacity: 2.6 vs 1.6 gha ≈ 1.7 Earths; overshoot as capital drawdown (resources).
- Renewable vs non-renewable with sustainable yield; the energy-transition trade-offs (resources).
- Water: agriculture ≈ 70% of withdrawals; security as access, not availability (resources).
- Food security's four pillars applied; famine amid availability; consumerism vs stewardship evaluated (security).

Boundary notes: the SL core paper rewards named PLACE examples at a stated SCALE (local, national, global) and precise use of "mitigation" and "adaptation"; the footprint, share and threshold figures above are the stable published values used as the unit's arithmetic spine.

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

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Options and fieldwork

IB Diploma Programme Geography SL (first assessment 2019; 2017 guide). This topic equips the THEMES menu and the INTERNAL ASSESSMENT: the seven option themes (SL schools teach two; each kit below gives the scope, one anchor concept and one place example) and the fieldwork inquiry cycle with its sampling strategies and statistics. The worked numbers are original and reconciled.

Must-know for options and fieldwork:

Family	Content
freshwater	drainage basin; storm hydrograph: rising limb, peak, lag time
coasts	erosion/deposition landforms; hard vs soft management
extreme	glacial and hot-arid processes; opportunity versus challenge
hazards	plate margins; risk = hazard × exposure × vulnerability
tourism	Butler's model; carrying capacity; Venice overtourism
food/health	epidemiological transition; famine and food systems
urban	land-use models; megacities; regeneration
fieldwork	question, hypotheses, sampling: random, systematic, stratified; r_s, χ^2

The seven option themes

FRESHWATER: the **drainage basin** is the unit of study; the **storm hydrograph** plots discharge against time – rising limb, peak, falling limb, and LAG TIME (storm to peak): urban basins shorten the lag and steepen the peak (concrete sheds water). Management runs from HARD engineering (dams, embankments) to SOFT (afforestation, river restoration, floodplain zoning), traded off against cost and ecology.

OCEANS AND COASTAL MARGINS: waves erode (hydraulic action, abrasion) and deposit (spits, beaches); landforms pair process with rock structure (headlands and bays, stacks). Coastal management: hard (groynes, sea walls – shifting the problem downdrift) versus SOFT (beach nourishment, MANGROVE planting) versus MANAGED REALIGNMENT – letting the coast adjust where defence costs exceed asset

value (a frequent evaluation case).

EXTREME ENVIRONMENTS: glacial processes (erosion by ice, transport, deposition: troughs, moraines) and hot-arid processes (wind and flash floods – dunes, wadis); each environment read as opportunity (tourism, minerals) against challenge (water, access, fragility).

GEOPHYSICAL HAZARDS: **plate margin** mechanics (constructive, destructive, conservative) drive volcanoes, earthquakes and tsunamis; hazard risk = hazard magnitude × exposure × vulnerability – which is why the same magnitude devastates one city and spares another (2011 Tōhoku: magnitude 9.0, world-class warning saved most lives; the tsunami still overwhelmed defences). Park's response curve models the human recovery arc.

LEISURE, TOURISM AND SPORT: tourism's global growth; the **Butler model** traces a destination from exploration through involvement, development and consolidation to stagnation, then decline or rejuvenation; **carrying capacity** and overtourism (Venice's day-tripper caps) demand management (limits, dispersal, pricing).

FOOD AND HEALTH: food systems from farm to table; famine as access failure (topic 02's pillar logic); the **epidemiological transition** – deaths shift from infectious diseases (stage 1) to chronic degenerative diseases (late stages) as development proceeds – with obesity rising where calories cheapen. Health indicators (life expectancy, infant mortality) track the transition.

URBAN ENVIRONMENTS: urbanisation and the growth of **megacities** (10 million plus); land-use models (Burgess's concentric zones, Hoyt's sectors – descriptions to test, not truths); urban stress (housing, congestion, waste) and regeneration (brownfield renewal, transport investment) as the response pair.

Fieldwork: geographic inquiry and sampling

The IA (25% at SL) is a FIELDWORK REPORT on primary data the student collects. THE CYCLE: a FIELDWORK QUESTION (place-specific and answerable) with one or more HYPOTHESES (testable, directional; for statistics, a NULL hypothesis of no relationship); METHODS chosen to match the question, with a RISK ASSESSMENT and ETHICS; DATA COLLECTION by SAMPLING, since a census is impossible: **Random sampling** (every point equally likely – unbiased, may miss clusters), **Systematic sampling** (every nth point or along a transect – even coverage, risks matching a periodic pattern) and **Stratified sampling** (proportional samples per known sub-zone – representative of structure, needs prior knowledge); point, line and quadrat frames; then PRESENTATION (maps, graphs), ANALYSIS, CONCLUSION and EVALUATION (limitations and modifications).

ANALYSIS runs from descriptive summaries (means, medians and the interquartile range) to statistical tests. SPEARMAN'S RANK measures a monotonic association. For eight pairs with no tied ranks, an exact two-sided test at the 5% level has a critical

absolute value of about 0.738. A reported $r_s = 0.714$ (rounded) is below this threshold, so do not reject the null hypothesis of no rank association; this does not prove that no association exists. State the sample size, treatment of ties, alternative hypothesis and test method. For a chi-squared independence test on a 2 x 2 count table, the degrees of freedom are 1. With independent observations and sufficiently large expected counts, $\chi^2 = 5.2 > 3.84$ rejects independence at the 5% level. Check these assumptions before using the chi-squared approximation.

> **Worked example.** Question: does pedestrian density fall with distance from the city-centre plaza? Hypothesis: density declines with distance. Method: systematic sampling – counts per 2 minutes at every 100 m along four transects (stratified by direction). Analysis: a scatter graph with Spearman's rank; evaluation: one rainy hour, four transects, morning only – the modifications name themselves.

Checklist

- Hydrograph anatomy with the urban lag-time effect; hard vs soft flood management (freshwater).
- Erosion/deposition process-landform pairs; groyne consequences vs managed realignment (coasts).
- Glacial and arid process pairs; the opportunity/challenge frame (extreme).
- Margin types with their hazards; the risk product with the Tōhoku contrast (hazards).
- Butler's stages in order; carrying capacity and Venice-style management (tourism).
- Epidemiological transition stages; famine as access failure (food and health).
- Burgess and Hoyt read as models to test; megacity growth, stress and regeneration (urban).
- The fieldwork cycle end to end; the three samplings' strengths and costs; the r_s and χ^2 decisions with critical values (fieldwork).

Boundary notes: option papers reward SPECIFIC PLACES at a stated scale, and the fieldwork criterion set marks EXPLAINED method choices and correctly executed statistics. All worked numbers are original.