

HOLIDAY HOMEWORK 假期作业

AP Environmental Science

Exercise sheets, topic by topic.

每个单元：练习卷。

For class or self-study • no answer keys included.

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1 Ecosystems and energy flow – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
ecosystem	生态系统	_____
Producers	生产者	_____
Consumers	消费者	_____
food chains	食物链	_____
food web	食物网	_____
trophic level	营养级	_____

Recall

You already know how living things depend on each other and their surroundings:

- Plants make food from sunlight; animals eat plants or other animals.
- A food chain shows who eats whom.
- Energy flows through nature and is gradually lost.

This sheet lines up how ecosystems move energy. Each idea has a short worked example.

New ideas

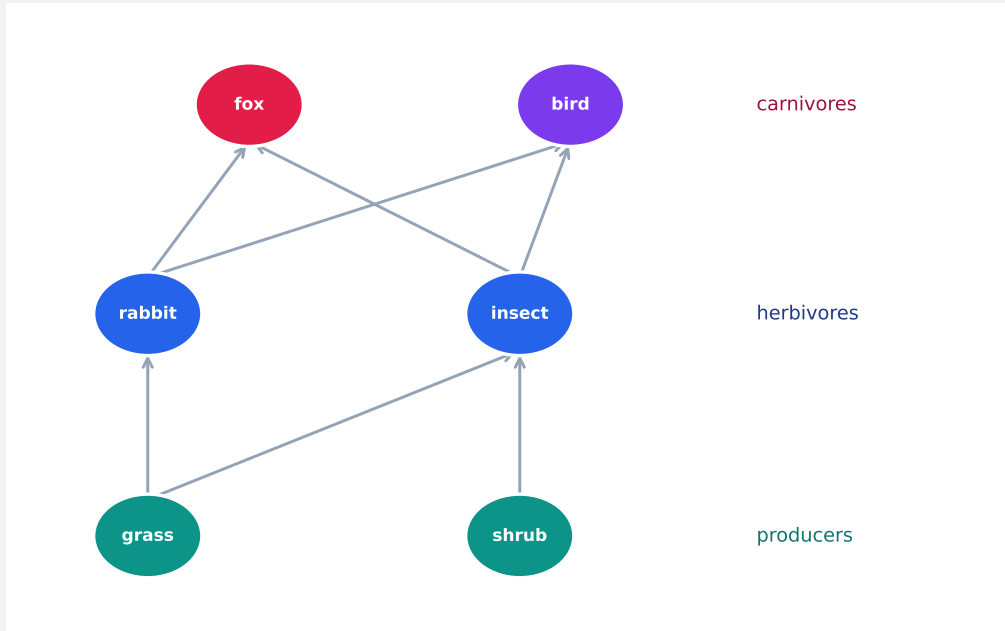
■ 1 Ecosystems

An **ecosystem** 生态系统 is all the living things in an area together with their non-living surroundings (water, soil, air). Energy enters as sunlight and flows through the living parts.

■ 2 Producers and consumers

- **Producers** 生产者 (plants) capture sunlight to make food.
- **Consumers** 消费者 eat producers or other consumers.

They form **food chains** 食物链 and, joined together, a **food web** 食物网.

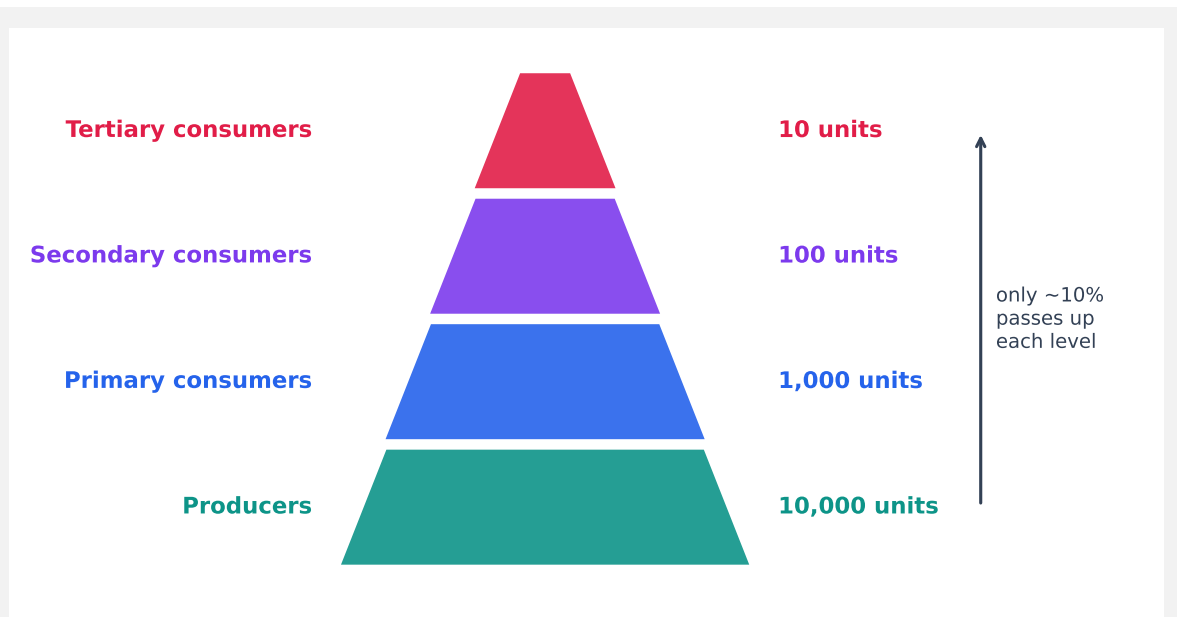


■ 3 Trophic levels

Each feeding step is a **trophic level** 营养级: producers, then primary, secondary, and tertiary consumers.

■ 4 The 10% rule

Only about **10%** of the energy passes from one trophic level to the next; the rest is lost as heat.



Worked example. If producers hold 10,000 units of energy, the next level gets about 1,000, then 100 –which is why top predators are few.

Watch out: so much energy is lost at each step (about 90%) that food chains rarely have more than four or five levels –there is not enough energy left to support another.

Practice

Try these in order. The methods are all above.

2.1 State what an ecosystem includes, both living and non-living. [2]

2.2 State the difference between a producer and a consumer. [2]

2.3 About what percentage of energy passes to the next trophic level? [1]

2.4 A producer level holds 5,000 units of energy. Estimate the energy at the next two

levels.

[2]

2.5 Explain why food chains are usually short (only a few levels).

[2]

1 Biogeochemical cycles – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
carbon cycle	碳循环	_____
water cycle	水循环	_____
nitrogen cycle	氮循环	_____

Recall

In Part A you followed energy through an ecosystem. Now follow the **matter**:

- Water evaporates, forms clouds, and falls as rain –the water cycle.
- Carbon moves between the air, living things, and the ground.
- Unlike energy, matter is **recycled** again and again.

Each idea has a short worked example before the Practice.

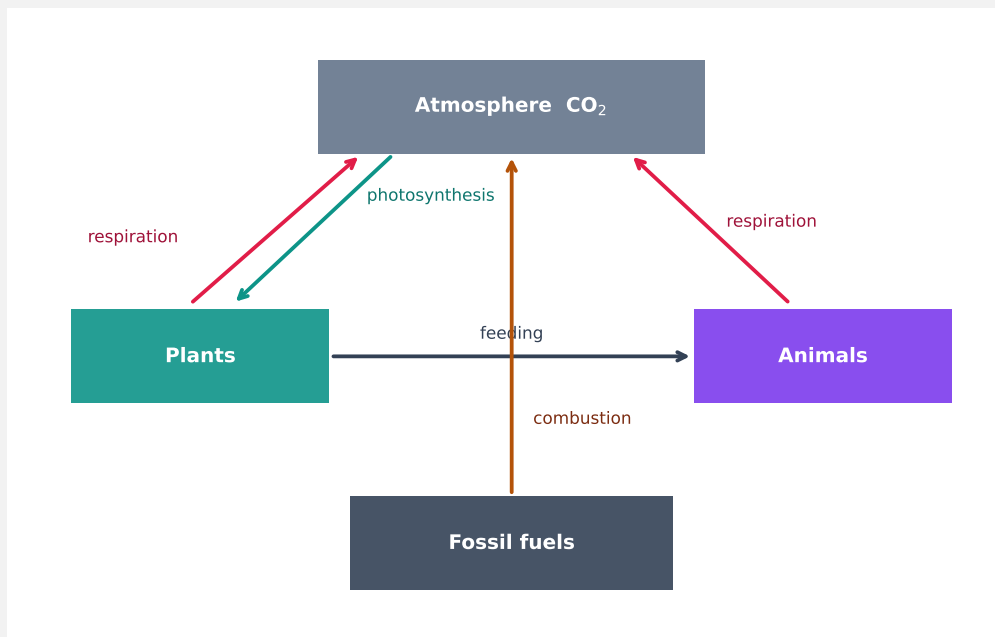
New ideas

■ 1 Matter cycles, energy flows

Energy flows one way and is lost as heat, but **matter** (carbon, nitrogen, water) is used over and over –it **cycles** between living things and the environment.

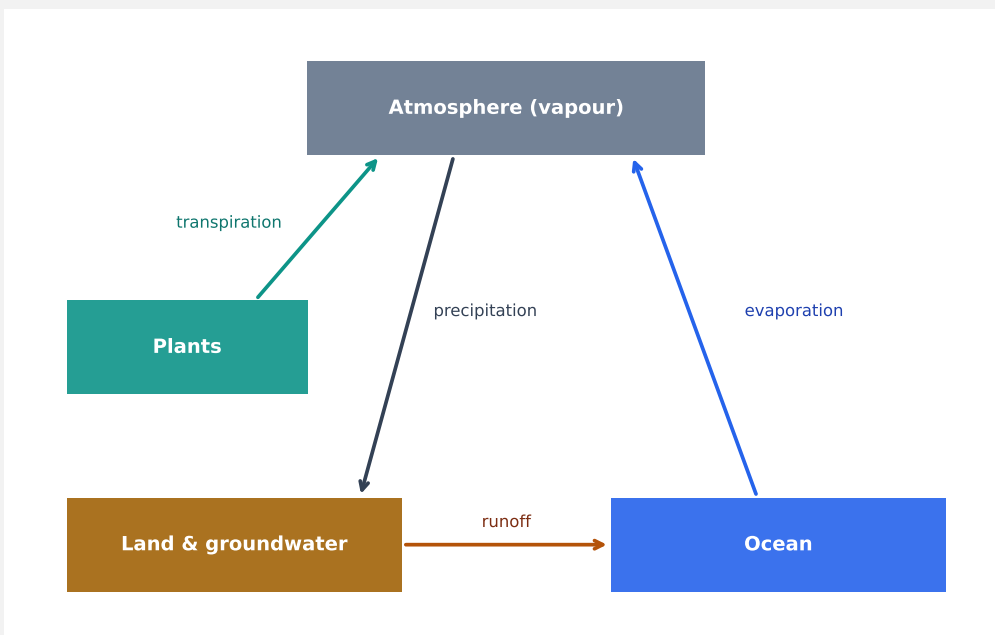
■ 2 The carbon cycle

In the **carbon cycle** 碳循环, carbon moves as CO₂: taken from the air by photosynthesis, returned by respiration and by burning fuels.



■ 3 The water cycle

In the **water cycle** 水循环, water evaporates from oceans, condenses into clouds, falls as rain, and runs back to the sea.



■ 4 The nitrogen cycle

In the **nitrogen cycle** 氮循环, nitrogen from the air is turned into forms plants can use (by bacteria), passed along food chains, and returned to the air.

Watch out: energy and matter behave differently –energy **flows through** an ecosystem and is lost, but matter **cycles** and is reused. Burning fossil fuels adds extra carbon to the air, upsetting the natural carbon cycle.

Practice

Try these in order. The methods are all above.

2.1 State the key difference between how energy and matter move through an ecosystem. [2]

2.2 State two processes that add carbon dioxide to the air, and one that removes it. [3]

2.3 List, in order, the main steps of the water cycle. [2]

2.4 State why plants cannot use nitrogen gas from the air directly. [1]

2.5 Explain how burning fossil fuels upsets the carbon cycle. [2]

2 Biodiversity and ecosystem services

– Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
Biodiversity	生物多样性	_____
species richness	物种丰富度	_____
Ecosystem services	生态系统服务	_____
range of tolerance	耐受范围	_____
optimal range	最适范围	_____

Recall

You already have a sense of nature's variety:

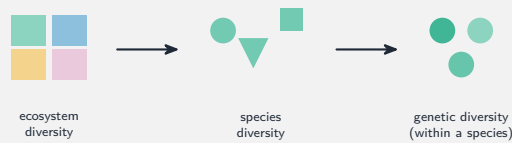
- Some places (like rainforests) have far more kinds of life than others (like deserts).
- Different animals and plants need different conditions to live.
- Nature gives us food, clean water, and clean air.

This sheet lines up how we describe and value that variety. Each idea has a short worked example.

New ideas

■ 1 Biodiversity

Biodiversity 生物多样性 is the variety of life, measured at three levels:



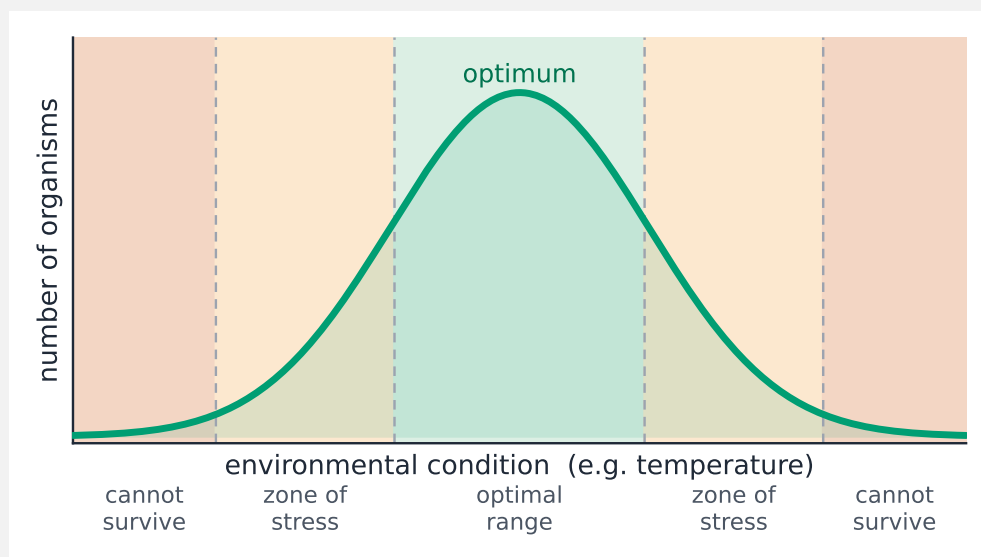
- **genetic** –variety of genes within a species,
- **species** –the number of different species (**species richness** 物种丰富度),
- **habitat** –the variety of habitats in a region.

■ 2 Ecosystem services

Ecosystem services 生态系统服务 are the free benefits nature gives people –food and water (provisioning), pollination and flood control (regulating), beauty and recreation (cultural), and nutrient cycling (supporting).

■ 3 Range of tolerance

Every species has a **range of tolerance** 耐受范围—the span of conditions (temperature, pH, salinity) it can survive. Near the middle is an **optimal range** 最适范围 where it thrives; toward the edges it is stressed; beyond the limits it dies.



■ 4 Diversity and resilience

More species-rich ecosystems are more **resilient** –they recover from disruption more easily, because different species can fill roles when conditions change.

Watch out: **specialist** species (with narrow needs) are far more vulnerable than **generalists** (which cope with many conditions). When a habitat changes, specialists disappear first.

Practice

Try these in order. The methods are all above.

2.1 Name the three levels at which biodiversity is measured. [3]

2.2 Give one example each of a provisioning and a regulating ecosystem service. [2]

2.3 State what the "optimal range" of a species is. [1]

2.4 Explain why a species-rich ecosystem is usually more resilient. [2]

2.5 State whether a specialist or a generalist species is more at risk when its habitat changes, and why. [2]

2 Succession and disturbance – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
Ecological succession	生态演替	_____
primary succession	初级演替	_____
secondary succession	次级演替	_____
pioneer species	先锋物种	_____
climax community	顶极群落	_____
keystone species	关键种	_____
indicator species	指示物种	_____

Recall

In Part A you met biodiversity. Now see how ecosystems change and rebuild:

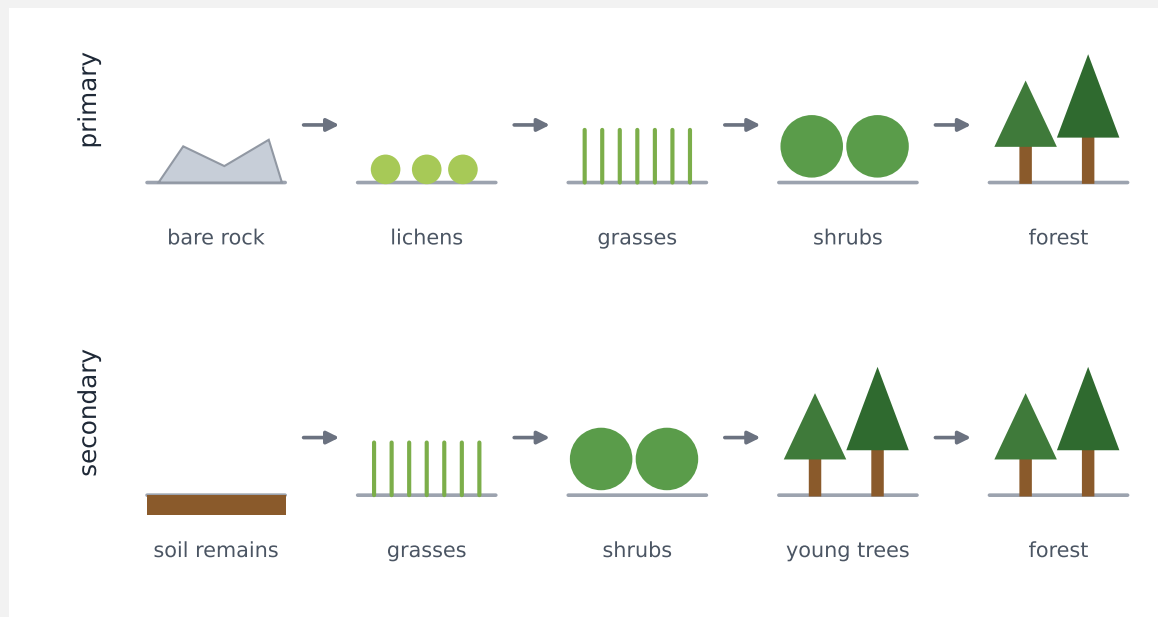
- After a fire or a landslide, plants slowly return.
- Some species matter far more to a community than their numbers suggest.

Each idea has a short worked example before the Practice.

New ideas

■ 1 Ecological succession

Ecological succession 生态演替 is the gradual, orderly change in a community over time.



- **primary succession** 初级演替 starts on bare rock with **no soil** (after a glacier or lava) –very slow,
- **secondary succession** 次级演替 follows a disturbance that leaves the soil (after a fire or farming) –much faster.

■ 2 Pioneers to climax

The first arrivals, **pioneer species** 先锋物种 like lichens, slowly build soil. Over time the community develops toward a stable **climax community** 顶极群落.

■ 3 Keystone species

A **keystone species** 关键种 has an effect far larger than its numbers –remove it and the whole community can collapse (like sea otters that keep sea urchins in check).

■ 4 Indicator species

An **indicator species** 指示物种 signals the health of an ecosystem by its presence or absence –lichens vanish where the air is polluted.

Watch out: primary succession is much **slower** than secondary succession, because it must first build soil from bare rock, while secondary succession already has soil to start from.

Practice

Try these in order. The methods are all above.

2.1 State the difference between primary and secondary succession.

[2]

2.2 Explain why primary succession is slower than secondary succession. [2]

2.3 Name a typical pioneer species and state what it does. [2]

2.4 State what a keystone species is. [2]

2.5 Explain how an indicator species can show that an ecosystem is polluted. [2]

3 Species strategies and population growth

– Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
generalist	广适性物种	_____
specialist	狭适性物种	_____
carrying capacity	环境容纳量	_____

Recall

You already know that populations of animals and plants change over time:

- A population can grow when food and space are plentiful.
- It cannot grow forever –something eventually limits it.
- Some animals have many young; others have just a few.

This sheet lines up how populations grow. Each idea has a short worked example.

New ideas

■ 1 Generalists and specialists

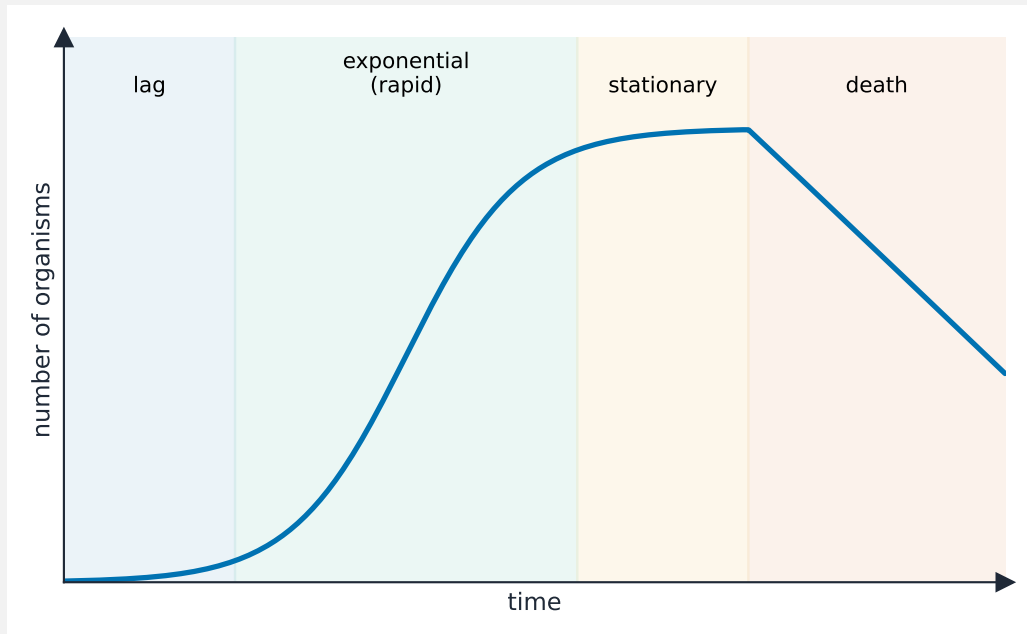
A **generalist** 广适性物种 can live in many places and eat many foods (a raccoon), so it copes well with change. A **specialist** 狭适性物种 needs specific conditions (a panda), so it is efficient but vulnerable if its habitat changes.

■ 2 Two reproductive strategies

- ***r*-selected** species have **many** offspring with little care (insects, weeds) –fast to grow, boom and bust.
- ***K*-selected** species have **few** offspring with much care (elephants, humans) –slow to recover from losses.

■ 3 Population growth

With plenty of resources a population grows **exponentially** (a J-shape). As resources run short, growth slows to a levelling **S-shape** at the **carrying capacity** 环境容纳量—the most the environment can support.



■ 4 Limiting factors

Food, water, space, disease, and predators are **limiting factors** that stop a population growing without end.

Watch out: a population can briefly **overshoot** its carrying capacity when resources are temporarily plentiful, then **crash** as those resources run out. Growth is not always smooth.

Practice

Try these in order. The methods are all above.

2.1 State the difference between a generalist and a specialist species. [2]

2.2 State one feature of an r -selected species and one of a K -selected species. [2]

2.3 State what "carrying capacity" means. [2]

2.4 Name three factors that can limit a population's size. [2]

2.5 Explain what happens when a population overshoots its carrying capacity. [2]

3 Human populations – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
age-structure diagram	年龄结构图	_____
total fertility rate	总生育率	_____

Recall

The human population has grown very fast, but not evenly everywhere:

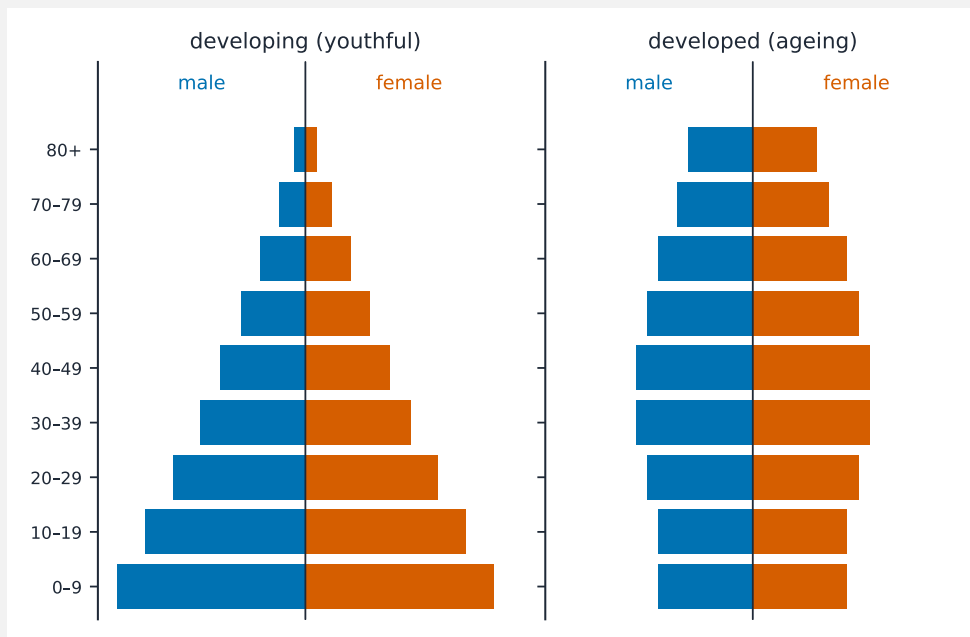
- Some countries have many young people; others have an ageing population.
- Birth rates are higher in some countries than others.

Each idea has a short worked example before the Practice.

New ideas

■ 1 Age-structure diagrams

An **age-structure diagram** 年龄结构图 shows how many people are in each age group. A **wide base** (many children) predicts rapid growth; even bars predict a stable population.



■ 2 Total fertility rate

The **total fertility rate** 总生育率 (TFR) is the average number of children per woman. A **replacement level** of about 2.1 keeps a population steady; above it grows, below it shrinks.

■ 3 Doubling time (rule of 70)

A population's doubling time is found from the **rule of 70**: divide 70 by the growth rate (as a percent).

Worked example. A country grows at 2.0% per year, so it doubles in about $\frac{70}{2.0} = 35$ years. At 3.5% it would double in only 20 years.

■ 4 The demographic transition

As a country develops, its growth changes in stages: (1) high birth and death rates, (2) death rate falls (fast growth), (3) birth rate falls (slowing), (4) both low (stable).

Watch out: a falling **growth rate** does not mean the population is shrinking –it is still growing, just more slowly. The population only shrinks when births fall below deaths.

Practice

Try these in order. The methods are all above.

2.1 State what a wide-based age-structure diagram tells you about a population. [1]

2.2 State the replacement-level total fertility rate and what it means. [2]

2.3 A population grows at 1.4% per year. Use the rule of 70 to find its doubling time.[2]

2.4 A population grows at 5.0% per year. Find its doubling time. [2]

2.5 Name two factors that tend to lower a country's birth rate as it develops. [2]

4 Rocks, soil, and the atmosphere – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
plates	板块	_____	_____	_____
plate tectonics	板块构造	_____	_____	_____
Soil	土壤	_____	_____	_____
weathers	风化	_____	_____	_____
Erosion	侵蚀	_____	_____	_____
texture	质地	_____	_____	_____
atmosphere	大气层	_____	_____	_____
troposphere	对流层	_____	_____	_____
stratosphere	平流层	_____	_____	_____

Recall

You already know some earth science:

- Earthquakes and volcanoes happen where Earth's surface is active.
- Soil grows plants, and it can be washed or blown away.
- Air is mostly nitrogen and oxygen.

This sheet lines up Earth's rocks, soil, and air. Each idea has a short worked example.

New ideas

■ 1 Plate tectonics

Earth's crust is broken into **plates** 板块 that slowly move –**plate tectonics** 板块构造. Where they pull apart, collide, or slide past, you get earthquakes, volcanoes, and mountains.

■ 2 Soil and erosion

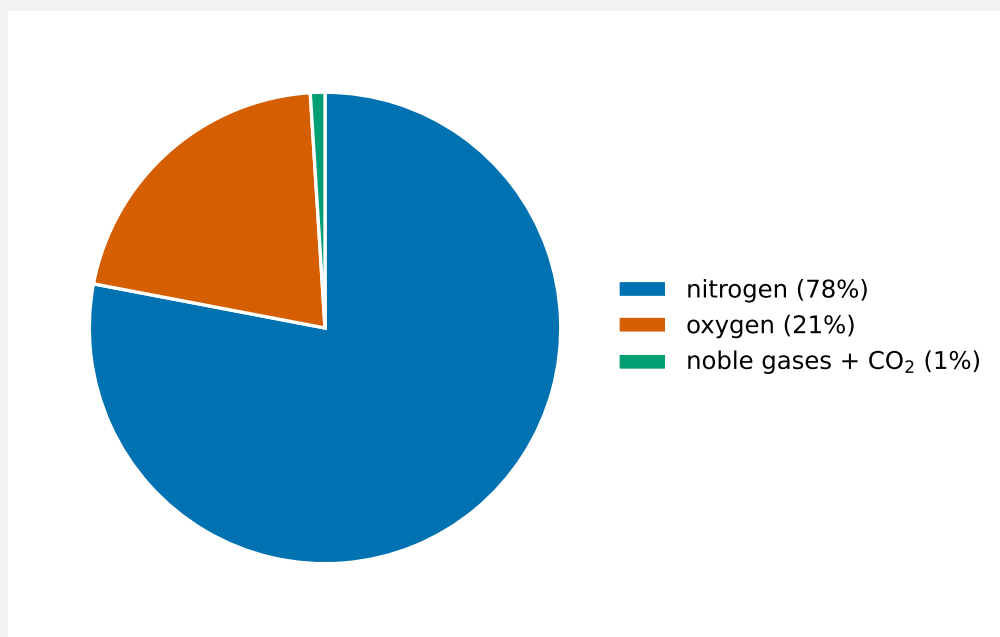
Soil 土壤 forms slowly as rock **weathers** 风化 and dead matter builds up. **Erosion** 侵蚀 is the removal of soil by wind and water, sped up when plants are removed (farming, deforestation).

■ 3 Soil texture

Soil is a mix of sand, silt, and clay –its **texture** 质地–plus water and air. Texture controls how well soil holds water and nutrients; a balanced mix (loam) is best for plants.

■ 4 The atmosphere

The **atmosphere** 大气层 is layered: the **troposphere** 对流层 (where weather happens) and the **stratosphere** 平流层 (holding the ozone layer). It is about 78% nitrogen and 21% oxygen.



Watch out: soil forms extremely slowly (centimetres over centuries). If erosion removes it faster than it forms, the land loses a vital resource that cannot be quickly replaced.

Practice

Try these in order. The methods are all above.

2.1 Name two things that happen where Earth's plates meet. [2]

2.2 State the difference between weathering and erosion. [2]

2.3 Name the three particle types that make up soil texture. [1]

2.4 Name the two main gases in the atmosphere and their approximate percentages. [2]

2.5 Explain why soil erosion is such a serious problem. [2]

4 Weather and climate – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
global wind patterns	全球风带	_____
Coriolis effect	科里奥利效应	_____
watershed	流域	_____
rain shadow	雨影	_____
El Niño	厄尔尼诺	_____
La Niña	拉尼娜	_____

Recall

You already notice weather and seasons:

- The Sun heats the equator more than the poles.
- Winds blow in fairly steady directions.
- Summer and winter come and go through the year.

This sheet lines up what drives weather and climate. Each idea has a short worked example.

New ideas

■ 1 Global winds

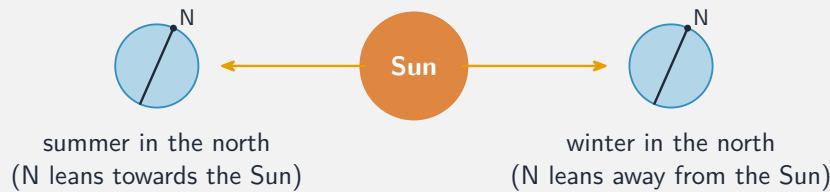
The Sun heats Earth unevenly, so warm air rises at the equator and sinks near the tropics, creating **global wind patterns** 全球风带. The spinning Earth bends these winds –the **Coriolis effect** 科里奥利效应.

■

A **watershed** 流域 is all the land that drains into a shared body of water. Whatever happens on that land –farming, paving, pollution –ends up in the water it drains into.

■ 3 Seasons come from the tilt

Seasons come from Earth's **tilted axis** (about 23.5°), not its distance from the Sun. The hemisphere tilted **toward** the Sun gets more direct light and longer days – summer.



■ 4 Climate patterns

Geography shapes climate: latitude, height, and nearness to oceans. Mountains create a **rain shadow** 雨影 (wet on the windward side, dry on the leeward side). **El Niño** 厄尔尼诺 and **La Niña** 拉尼娜 are shifts in Pacific temperatures that change rainfall worldwide.

Watch out: seasons are caused by the Earth's **tilt**, not by how close it is to the Sun. In fact the Earth is slightly closer to the Sun during the northern winter.

Practice

Try these in order. The methods are all above.

2.1 State what causes global wind patterns. [2]

2.2 State what a watershed is. [2]

2.3 Explain what really causes the seasons. [2]

2.4 Explain why one side of a mountain range is much drier than the other (a rain

shadow). [2]

2.5 State what El Niño and La Niña are. [1]

5 Using the land – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
tragedy of the commons	公地悲剧	_____
green revolution	绿色革命	_____
Irrigation	灌溉	_____
Deforestation	森林砍伐	_____

Recall

You already know that people use the land in many ways:

- Farms grow the food we eat.
- Forests are cut down for wood and to clear land.
- Shared resources, like fish in the sea, can be used up.

This sheet lines up how we use the land. Each idea has a short worked example.

New ideas

■ 1 The tragedy of the commons

When a resource is shared by everyone and owned by no one, each person takes as much as they can, and it gets overused –the **tragedy of the commons** 公地悲剧 (like overfishing a shared sea).

■ 2 The green revolution

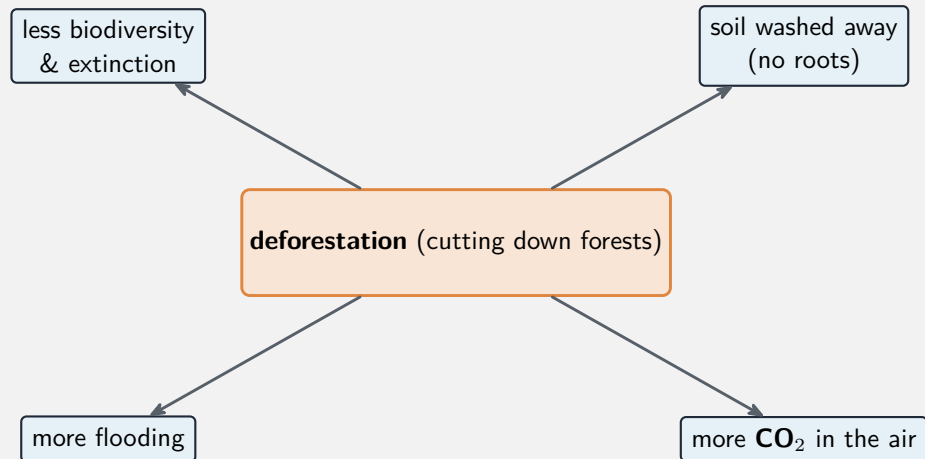
The **green revolution** 绿色革命 raised crop yields with modern methods –fertilizers, irrigation, machines, and improved seeds –but these bring costs like pollution and heavy water use.

■ 3 Irrigation

Irrigation 灌溉 supplies water to crops. It boosts harvests but can drain rivers and aquifers, and can leave salt behind in the soil (salinization).

■ 4 Deforestation

Deforestation 森林砍伐 (clearing forests) removes habitat, causes soil erosion and flooding, and releases stored carbon dioxide.



Watch out: the tragedy of the commons happens because **no single person owns** the resource, so each gains from taking more while everyone shares the cost of overuse. Clear rules or ownership can prevent it.

Practice

Try these in order. The methods are all above.

2.1 Explain what the "tragedy of the commons" is, with an example. [2]

2.2 State one benefit and one cost of the green revolution. [2]

2.3 State one problem that irrigation can cause. [1]

2.4 List three harmful effects of deforestation. [3]

2.5 Suggest one way to prevent the overuse of a shared resource. [1]

5 Impacts and sustainability – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
Overfishing	过度捕捞	_____
Urbanization	城市化	_____
ecological foot- print	生态足迹	_____
Sustainability	可持续性	_____

Recall

In Part A you saw how using land can harm the environment. Now measure that impact and reduce it:

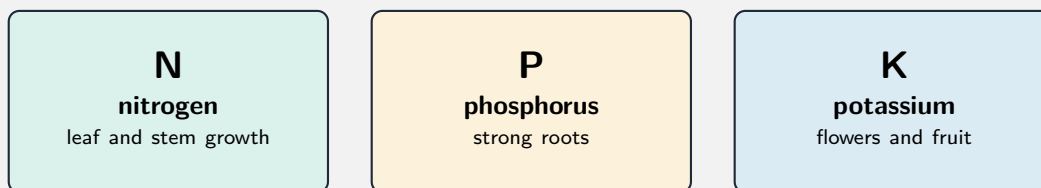
- Cities, mines, and fishing fleets all leave a mark on nature.
- We talk about living "sustainably" –using resources without using them up.

Each idea has a short worked example before the Practice.

New ideas

■ 1 Impacts of using resources

- **Overfishing** 过度捕捞 removes fish faster than they can breed, collapsing stocks.
- **Mining** scars the land and can pollute water.
- **Urbanization** 城市化 covers land with roads and buildings, increasing runoff and pollution.



NPK fertilisers contain all three - ammonium salts and nitrates supply the nitrogen

■ 2 Ecological footprint

An **ecological footprint** 生态足迹 measures the land and water one person needs to supply their resources and absorb their wastes. Wealthy, high-consumption lifestyles have much larger footprints.

Worked example. Earth provides about 1.6 global hectares per person. If someone's footprint is 8 global hectares, it would take $\frac{8}{1.6} = 5$ Earths if everyone lived that way.

■ 3 Sustainability

Sustainability 可持续性 means meeting today's needs without harming the ability of future generations to meet theirs –using resources no faster than they renew.

■ 4 Sustainable methods

Better practices reduce harm: **integrated pest management** (using natural predators plus minimal pesticide), crop rotation, sustainable forestry (replanting), and fishing limits.

Watch out: an ecological footprint is measured **per person**, so a small rich country can have a bigger total impact than a large poor one. Consumption per person, not just population, drives the footprint.

Practice

Try these in order. The methods are all above.

2.1 Explain what overfishing is and why it is a problem. [2]

2.2 State one environmental impact of urbanization. [1]

2.3 An average footprint is 2.4 global hectares and Earth provides 1.6 per person. Find

how many Earths would be needed if everyone lived this way. [2]

2.4 State what "sustainability" means. [2]

2.5 Give one sustainable farming or fishing practice. [1]

6 Non-renewable energy – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
renewable resource	可再生资源	_____
non-renewable resource	不可再生资源	_____
Fossil fuels	化石燃料	_____
Nuclear power	核能	_____
fission	裂变	_____

Recall

You already use energy from many sources:

- Coal, oil, and natural gas are burned for electricity and transport.
- Nuclear power stations make electricity without burning fuel.
- Some energy sources will eventually run out.

This sheet lines up the non-renewable energy sources. Each idea has a short worked example.

New ideas

■ 1 Renewable and non-renewable

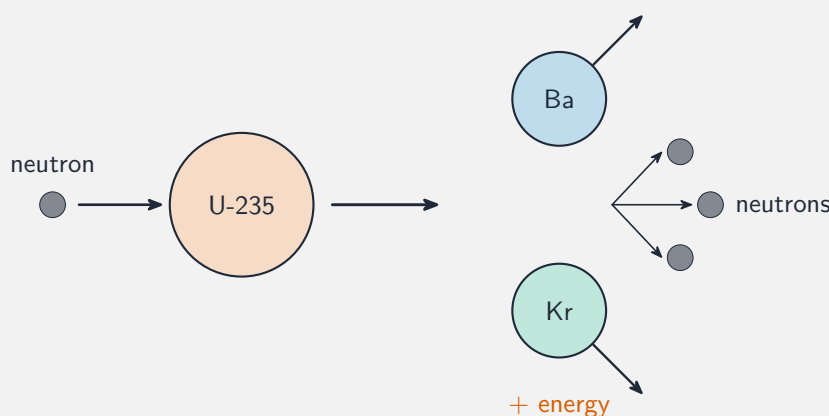
A **renewable resource** 可再生资源 replenishes on a human timescale (sun, wind, water). A **non-renewable resource** 不可再生资源 exists in fixed amounts that take millions of years to form (fossil fuels, nuclear fuel).

■

Fossil fuels 化石燃料 (coal, oil, gas) are energy-dense and reliable, but they are non-renewable and release **carbon dioxide** and other pollutants when burned.

■ 3 Nuclear power

Nuclear power 核能 splits uranium (**fission** 裂变) to make heat and then electricity. It produces **no CO₂**, but leaves long-lived radioactive **waste**.



■ 4 The half-life of waste

Radioactive waste decays by its **half-life** –the time for half of it to decay.

Worked example. If an isotope has a half-life of 30 years and you start with 100 g, after 30 years 50 g remains, after 60 years 25 g, and after 90 years just 12.5 g.

Watch out: nuclear power makes no CO₂, but its waste stays dangerous for a very long time (many half-lives), so it must be stored safely for centuries.

Practice

Try these in order. The methods are all above.

2.1 State the difference between a renewable and a non-renewable resource. [2]

2.2 State one advantage and one disadvantage of fossil fuels. [2]

2.3 State one advantage and one disadvantage of nuclear power. [2]

2.4 An isotope has a half-life of 10 years. Starting with 80 g, how much remains after 30 years? [3]

2.5 Explain why nuclear waste must be stored safely for a very long time. [2]

6 Renewable energy and conservation

– Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
solar	太阳能	_____	_____	_____
wind	风能	_____	_____	_____
hydroelectric	水电	_____	_____	_____
geothermal	地热能	_____	_____	_____
Biomass	生物质	_____	_____	_____
hydrogen fuel cell	氢燃料电池	_____	_____	_____
Energy conservation	节能	_____	_____	_____

Recall

In Part A you met fossil fuels and nuclear power. Now the cleaner alternatives:

- Solar panels and wind turbines make electricity without burning anything.
- Dams use flowing water to generate power.
- Saving energy is often the cheapest option of all.

Each idea has a short worked example before the Practice.

New ideas

■ 1 The main renewables

Clean, renewable sources make electricity without fuel:

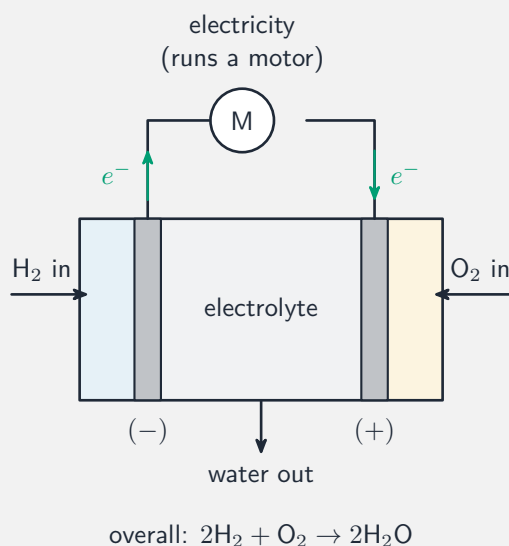
- **solar** 太阳能—from sunlight (but only in daytime),
- **wind** 风能—from moving air (but only when it blows),
- **hydroelectric** 水电—from flowing water in dams,
- **geothermal** 地热能—from Earth's internal heat.

■ 2 Their trade-offs

They are clean during use, but many are **intermittent** (sun and wind come and go) and need particular locations or large areas.

■ 3 Biomass and hydrogen

Biomass 生物质 (wood, crops, waste) is renewable but pollutes when burned. A **hydrogen fuel cell** 氢燃料电池 makes electricity from hydrogen and oxygen, with only water as waste.



■ 4 Energy conservation

Energy conservation 节能—using less through efficient lights, insulation, and public transport —is often the cheapest and cleanest choice, because the energy you do not use needs no fuel.

Watch out: solar and wind are **intermittent** —they only produce power when the sun shines or the wind blows —so they usually need storage (batteries) or a backup supply to give steady electricity.

Practice

Try these in order. The methods are all above.

2.1 Name four renewable sources of electricity.

[2]

2.2 State what "intermittent" means for solar and wind power. [2]

2.3 State the only waste product of a hydrogen fuel cell. [1]

2.4 Explain why energy conservation is often described as the cheapest and cleanest option. [2]

2.5 Give one drawback of hydroelectric dams. [1]

7 Air pollution and smog – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
Air pollution	空气污染	_____
Primary pollutants	一次污染物	_____
secondary pollutants	二次污染物	_____
Photochemical smog	光化学烟雾	_____
ozone	臭氧	_____
thermal inversion	逆温	_____
Particulate matter	颗粒物	_____

Recall

You already know the air can become dirty:

- Cars, factories, and power stations release smoke and gases.
- Smog can hang over busy cities.
- Breathing polluted air is bad for your health.

This sheet lines up the main air pollutants. Each idea has a short worked example.

New ideas

■ 1 Air pollution

Air pollution 空气污染 is harmful substances in the atmosphere. **Primary pollutants** 一次污染物 are released directly (carbon monoxide, nitrogen oxides, sulfur

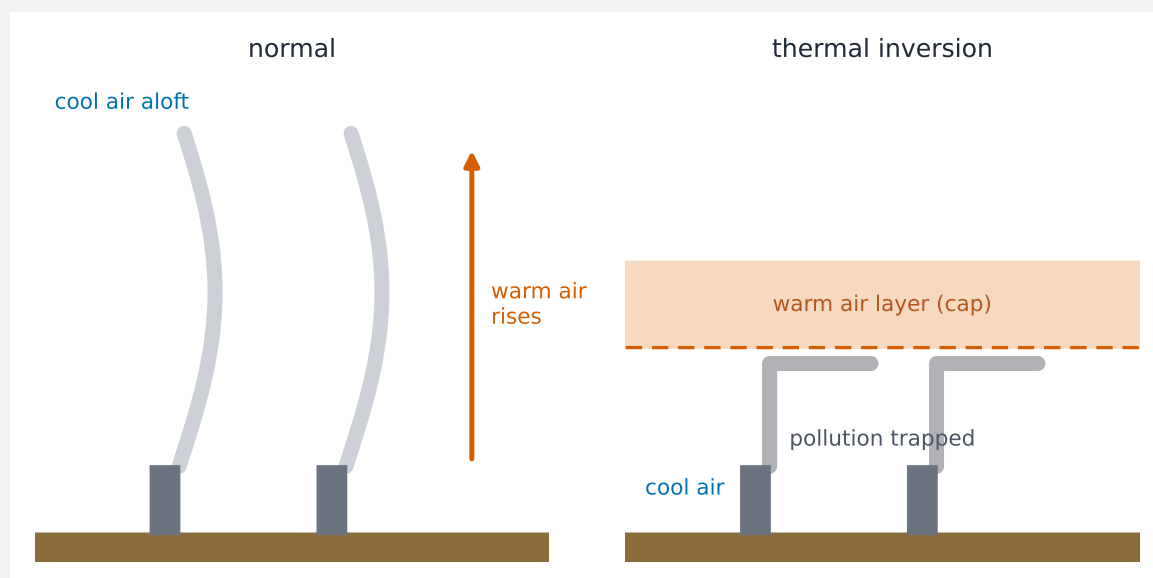
dioxide, particulates); **secondary pollutants** 二次污染物 form later in the air from reactions.

■ 2 Photochemical smog

Photochemical smog 光化学烟雾 forms when **sunlight** drives reactions among car-exhaust gases, producing ground-level **ozone** 臭氧. It is worst in sunny, car-heavy cities and harms the lungs.

■ 3 Thermal inversion

Normally warm air rises and carries pollution away. In a **thermal inversion** 逆温, a layer of warm air sits **above** the cooler air, trapping pollutants near the ground and causing dangerous smog.



■ 4 Particulate matter

Particulate matter 颗粒物 is tiny solid or liquid particles that get deep into the lungs, causing breathing and heart problems and reducing visibility.

Watch out: ground-level ozone (in smog) is a **harmful pollutant**, but the ozone **layer** high in the atmosphere is **protective** –it shields us from the Sun’s UV. Same molecule, opposite roles depending on where it is.

Practice

Try these in order. The methods are all above.

2.1 State the difference between a primary and a secondary pollutant.

[2]

2.2 State what is needed for photochemical smog to form. [2]

2.3 Explain how a thermal inversion makes air pollution worse. [2]

2.4 State one health effect of particulate matter. [1]

2.5 Explain why ground-level ozone is harmful but the ozone layer is helpful. [2]

7 Acid rain and cleaning the air – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
Acid rain	酸雨	_____	_____	_____
radon	氡	_____	_____	_____
asbestos	石棉	_____	_____	_____
catalytic converters	催化转化器	_____	_____	_____
Noise pollution	噪声污染	_____	_____	_____

Recall

In Part A you met air pollutants. Now their effects and how we clean the air:

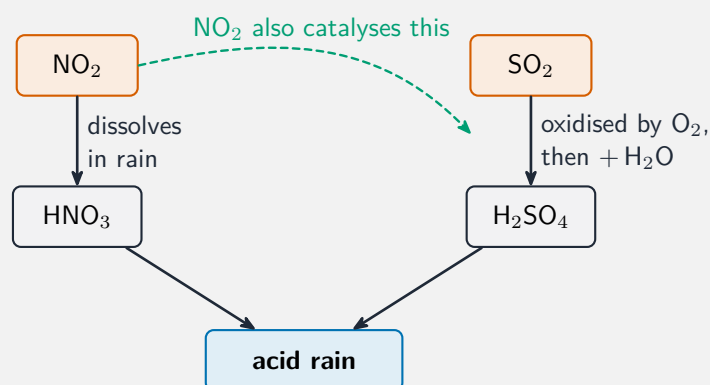
- Rain can become acidic and damage lakes and forests.
- Cars have devices that clean their exhaust.

Each idea has a short worked example before the Practice.

New ideas

■ 1 Acid rain

Acid rain 酸雨 forms when sulfur dioxide and nitrogen oxides react with water in the air to make acids, which fall far downwind. It harms lakes and fish, damages trees, and corrodes buildings.

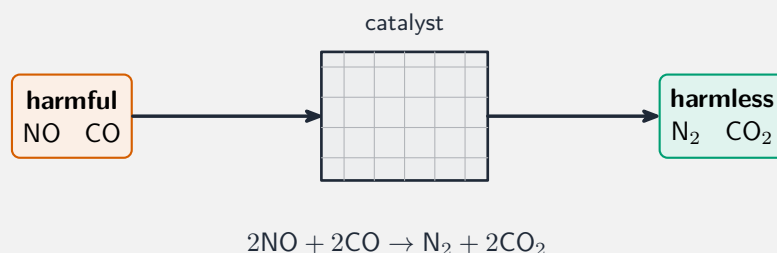


■ 2 Indoor air pollution

Indoor air can be worse than outdoor air. Common indoor pollutants include **radon** 氡 (a radioactive gas from the ground), carbon monoxide, and **asbestos** 石棉.

■ 3 Cleaning the air

Pollution is cut by technology and law: **catalytic converters** 催化转化器 on cars turn harmful gases into harmless ones, scrubbers clean smokestacks, and cleaner fuels and emission laws reduce pollution at the source.



■ 4 Noise pollution

Noise pollution 噪声污染 is unwanted or harmful sound –from traffic, aircraft, and industry. It causes hearing loss and stress in people and disturbs wildlife.

Watch out: acid rain often falls **far from where the pollution was released**, because the gases travel on the wind –so the country causing it may not be the one harmed.

Practice

Try these in order. The methods are all above.

2.1 State the two gases that cause acid rain.

[2]

2.2 List two kinds of damage caused by acid rain. [2]

2.3 Name one indoor air pollutant and state its danger. [2]

2.4 State what a catalytic converter does. [2]

2.5 Explain why acid rain can be an international problem. [2]

8 Water pollution and biomagnification – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
eutrophication	富营养化	_____
Thermal pollution	热污染	_____
Bioaccumulation	生物累积	_____
Biomagnification	生物放大	_____

Recall

You already know water can be polluted:

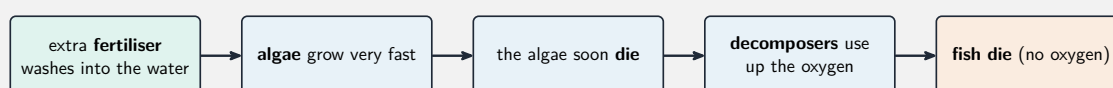
- Sewage, fertilizer, and factory waste can enter rivers and seas.
- Too much fertilizer can cause a green bloom of algae in a pond.
- Some poisons build up in animals over time.

This sheet lines up water pollution. Each idea has a short worked example.

New ideas

■ 1 Eutrophication

When extra nutrients (from fertilizer or sewage) enter water, they cause **eutrophication** 富营养化: algae bloom, then die and rot, using up the oxygen, which suffocates fish.



■ 2 Thermal pollution

Thermal pollution 热污染 is warm water released by power plants; warm water holds less oxygen, stressing aquatic life.

■ 3 Bioaccumulation and biomagnification

Bioaccumulation 生物累积 is the build-up of a toxin **inside one organism** over its life. **Biomagnification** 生物放大 is the increase in concentration **up the food chain**, so top predators end up with the most.

■ 4 Biomagnification in numbers

Worked example. If water holds a toxin at 0.01 ppm, plankton might reach 0.5 ppm, small fish 2 ppm, and a top predator 25 ppm –about 2500 times the level in the water.

Watch out: because toxins **biomagnify**, a top predator (like an eagle or a large fish) can be poisoned even when the water itself is only lightly polluted.

Practice

Try these in order. The methods are all above.

2.1 Explain the steps of eutrophication, from fertilizer runoff to dead fish. [3]

2.2 State why warm water from power plants harms aquatic life. [2]

2.3 State the difference between bioaccumulation and biomagnification. [2]

2.4 A toxin is 0.02 ppm in water and 40 ppm in a top predator. Find how many times more concentrated it is in the predator. [2]

2.5 Explain why top predators are most affected by biomagnification.

[2]

8 Waste, sewage, and health – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
sanitary landfills	卫生填埋场	_____
Sewage treatment	污水处理	_____
LD50	半数致死量	_____
Pathogens	病原体	_____

Recall

In Part A you met water pollution. Now waste, sewage, and toxic chemicals:

- We throw away huge amounts of rubbish.
- Sewage must be cleaned before it returns to rivers.
- Some substances are far more poisonous than others.

Each idea has a short worked example before the Practice.

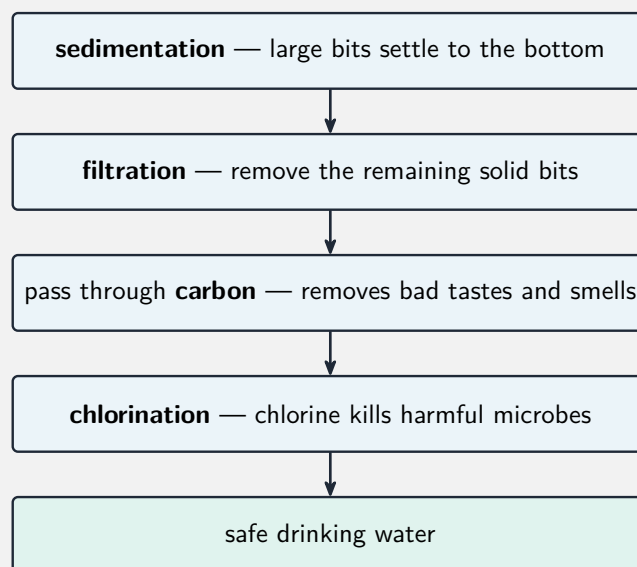
New ideas

■ 1 Solid waste

Rubbish is buried in **sanitary landfills** 卫生填埋场 or burned in incinerators. Both have costs, so the best approach is **reduce, reuse, recycle** –reducing waste is best of all.

■ 2 Sewage treatment

Sewage treatment 污水处理 cleans wastewater in stages: settling out solids, then bacteria breaking down organic matter, and sometimes removing nutrients and disinfecting. This protects rivers from disease and nutrient pollution.



■ 3 How toxic is it? (LD50)

The **LD50** 半数致死量 is the dose that kills **half** of a test population. A **lower** LD50 means a **more toxic** substance –less is needed to be deadly.

Worked example. Chemical A has an LD50 of 5 mg/kg and chemical B has 500 mg/kg. A is 100 times more toxic, because far less of it is lethal.

■ 4 Pathogens

Pathogens 病原体 (disease-causing microbes) spread through contaminated water and food, causing diseases like cholera. Clean water and good sanitation are the main defences.

Watch out: a **lower** LD50 means **more** toxic (a small dose is deadly). Don't read a bigger number as "more dangerous" –it is the other way round.

Practice

Try these in order. The methods are all above.

2.1 State the "reduce, reuse, recycle" order and which is best. [2]

2.2 Describe, in order, the main stages of sewage treatment. [2]

2.3 State what the LD50 of a substance measures. [2]

2.4 Chemical X has an LD50 of 10 mg/kg and chemical Y has 200 mg/kg. State which is more toxic and by how many times. [2]

2.5 State how pathogens most commonly spread, and one way to prevent it. [2]

9 Ozone depletion and climate change

– Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
ozone layer	臭氧层	_____	_____	_____
ultraviolet	紫外线	_____	_____	_____
CFCs	氯氟烃	_____	_____	_____
Montreal Protocol	蒙特利尔 议定书	_____	_____	_____
greenhouse effect	温室效应	_____	_____	_____
greenhouse gases	温室气体	_____	_____	_____
methane	甲烷	_____	_____	_____
climate change	气候变化	_____	_____	_____

Recall

You have probably heard about these global problems:

- The "ozone hole" high in the atmosphere.
- Global warming and the greenhouse effect.
- Carbon dioxide building up from burning fuels.

This sheet lines up ozone depletion and climate change –two different problems. Each idea has a short worked example.

New ideas

■ 1 Ozone depletion

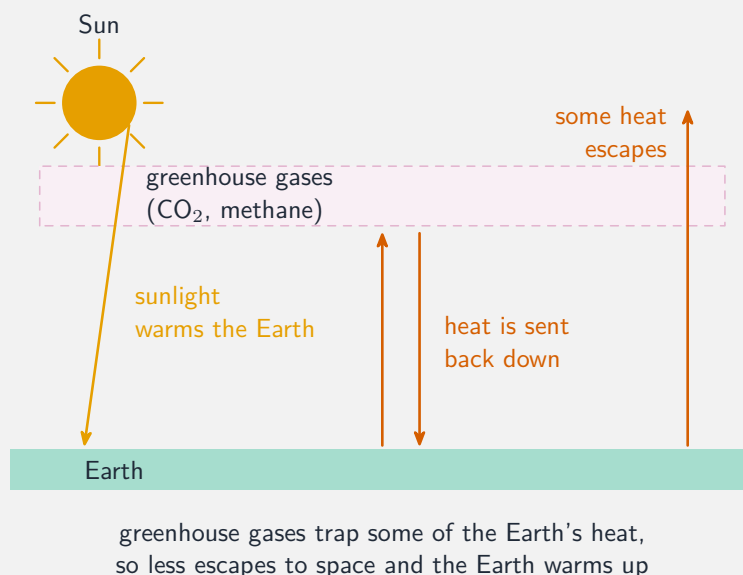
The **ozone layer** 臭氧层 high up absorbs harmful **ultraviolet** 紫外线 rays. **CFCs** 氯氟烃 (once used in fridges and sprays) destroy ozone, thinning it (the ozone hole) and letting more UV reach the surface.

■ 2 A rare success

The **Montreal Protocol** 蒙特利尔议定书 (1987) banned CFCs worldwide, and the ozone layer is slowly recovering –a rare environmental success story.

■ 3 The greenhouse effect

The **greenhouse effect** 温室效应 keeps Earth warm: **greenhouse gases** 温室气体 let sunlight in but trap the heat the Earth gives off. This is natural and makes Earth livable.



■ 4 Climate change

Humans add extra greenhouse gases –CO₂ from burning fuels and **methane** 甲烷 from livestock –strengthening the effect. This causes **climate change** 气候变化: warming, melting ice, rising seas, and more extreme weather.

Watch out: ozone depletion and climate change are **two different problems**. Ozone depletion is CFCs letting in more UV; climate change is greenhouse gases trapping more heat. Don't mix them up.

Practice

Try these in order. The methods are all above.

2.1 State what the ozone layer does and what damages it.

[2]

2.2 State why the Montreal Protocol is considered a success. [2]

2.3 Explain the natural greenhouse effect. [2]

2.4 Name two greenhouse gases and a human source of each. [2]

2.5 State one difference between ozone depletion and climate change. [2]

9 Oceans and biodiversity loss – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
coral bleaching	珊瑚白化	_____
ocean acidification	海洋酸化	_____
calcium carbonate	碳酸钙	_____
invasive species	入侵物种	_____
endangered species	濒危物种	_____

Recall

In Part A you met climate change. Now its effects on the oceans and on living things:

- Warmer seas harm coral reefs.
- Some species are being pushed toward extinction.
- Animals moved to new places can cause damage.

Each idea has a short worked example before the Practice.

New ideas

■ 1 Ocean warming

The oceans absorb most of the extra heat. Warmer water causes **coral bleaching** 珊瑚白化 (corals lose their algae and can die), and –with melting ice –raises sea level.

■ 2 Ocean acidification

The ocean absorbs some of our CO₂, which forms acid –**ocean acidification** 海洋酸化. Lower pH makes it harder for corals and shellfish to build their **calcium carbonate** 碳酸钙 shells.

■ 3 Invasive species

An **invasive species** 入侵物种 is a non-native species that spreads and harms its new home. With no natural predators, it outcompetes native species and reduces biodiversity.

■ 4 Endangered species

An **endangered species** 濒危物种 is at risk of extinction. The main causes are remembered as **HIPPO**: Habitat loss, Invasive species, Pollution, Population growth, and Overharvesting.



Watch out: an invasive species is dangerous precisely **because it is not native** – it has no natural predators or diseases in the new place to keep its numbers in check, so it can spread unchecked.

Practice

Try these in order. The methods are all above.

2.1 State what causes coral bleaching. [1]

2.2 Explain how ocean acidification harms shellfish and corals. [2]

2.3 State what makes a species "invasive" and why it can spread so easily. [2]

2.4 State what the letters in HIPPO stand for. [2]

2.5 Give two ways people protect endangered species.

[2]
