

GAC023 Science III: General Science

GAC Science

What this module is, and how it is marked

GAC023 is combined science: biology, chemistry, earth science and physics in one semester. The aim is confident general science **in English**, not specialist depth in one subject.

Assessment includes a **collaborative investigation** 合作探究 planned and run as a group, a written report using internet research, a test, and coursework.

- The breadth is deliberate. Questions ask you to connect areas — how chemistry affects an ecosystem, how a wave carries energy — rather than to go deep in one.
- △ Report writing rules from GAC013 apply unchanged here, and they are marked again.

The history, nature and practice of biology

- **Biology** 生物学 studies living things, and what counts as living is itself a definition to learn: it takes in energy, responds, grows, reproduces, and maintains itself.
- The **cell** 细胞 is the unit of life. **Prokaryotic** 原核 cells have no nucleus; **eukaryotic** 真核 cells do.
- **Homeostasis** 稳态 is keeping internal conditions steady while outside conditions change.

The classification of living things

- **Classification** 分类 groups organisms by shared ancestry, not by appearance.
- The hierarchy runs kingdom, phylum, class, order, family, genus, **species** 物种.
- **Binomial nomenclature** 双名法 gives each species a two-part Latin name, and the convention — genus capitalised, species not, both italic — is examinable.

Ecosystems

- An **ecosystem** 生态系统 is the organisms in an area plus the non-living conditions they live in.
- **Producers** 生产者 make their own food; **consumers** 消费者 eat others; **decomposers** 分解者 return nutrients to the soil.

- Energy **flows** through a food chain and is lost at each step; matter **cycles** and is not.
- **Biodiversity** 生物多样性 measures the variety of life, and it is what makes an ecosystem resilient to change.

Worked example. Why is a food chain rarely longer than five links?

About 90% of the energy at each level is lost as heat and in movement. After four transfers roughly one part in ten thousand of the original energy remains — not enough to support another level of predators.

The question is really about energy, and answering it in energy terms is what earns the marks.

Earth resources

- The **rock cycle** 岩石循环 forms igneous, sedimentary and metamorphic rock, and turns each into the others over time.
- **Renewable** 可再生 resources replace themselves within a human lifetime; **non-renewable** 不可再生 ones do not.
- The **water cycle** 水循环 moves water through evaporation, condensation, precipitation and runoff, and it is the clearest example of a closed cycle you can draw.

Chemistry

- An **atom** 原子 has a nucleus of protons and neutrons with electrons around it.
- The **atomic number** 原子序数 is the proton count and identifies the element; the **mass number** 质量数 counts protons plus neutrons; **isotopes** 同位素 differ only in neutrons.
- The **periodic table** 元素周期表 orders elements by atomic number, and its columns share chemical behaviour because they share outer electrons.
- **Ionic bonds** 离子键 transfer electrons; **covalent bonds** 共价键 share them.

Chemistry and the environment

- **Combustion** 燃烧 of fossil fuels releases carbon dioxide, which is the mechanism behind the **greenhouse effect** 温室效应.
- **Acid rain** 酸雨 forms when sulfur and nitrogen oxides dissolve in water vapour.
- **Pollution** 污染 is a chemistry problem with a policy answer, and questions expect you to separate the two.

Physics

- A **wave** 波 transfers energy without transferring matter.
- **Frequency** 频率, **wavelength** 波长 and **speed** 波速 are related by $v = f\lambda$.
- **Transverse waves** 横波 oscillate across the direction of travel; **longitudinal waves** 纵波 oscillate along it.
- The **electromagnetic spectrum** 电磁波谱 runs from radio to gamma, all travelling at the same speed in a vacuum and differing only in frequency.

Worked example. A wave has frequency 250 Hz and wavelength 1.4 m. How fast does it travel?

$$v = f\lambda = 250 \times 1.4 = 350 \text{ m/s}$$

Roughly the speed of sound in air, which is a useful check: an answer of 350 000 m/s would tell you the units went wrong somewhere.