



General Certificate of Education
Advanced Subsidiary Examination
January 2009

General Studies (Specification A)

GENA2

Unit 2 AS Science and Society

Source Booklet

Source for use with Questions 1.1 to 1.30

SOURCE FOR QUESTIONS 1.1 TO 1.30

Consider the following passage, including **Boxes 1 to 4** and **Figures 1 to 4** and then answer **Questions 1.1 to 1.30**.

Careless science costs lives**The public is wrong to regard all profit-driven research as suspect**

1) In science, as in much of life, it is believed that you get what you pay for. According to opinion polls, people do not trust scientists who work for industry because they only care about profits, or government scientists because they suspect them of trying to cover up the truth. Scientists who work for environmental Non-Governmental Organisations (NGOs) are more highly regarded. Because such scientists are trying to save the planet, people are ready to believe that what they say must be true. A House of Lords report, *Science and Society*, published in 2000, agreed that motives matter. It argued that science and scientists are not value-free and, therefore, that scientists would command more trust “if they openly declare the values that underpin their work”.

2) It all sounds very plausible, but mostly it is wrong. Scientists with the best of motives can produce bad science, just as scientists whose motives are suspect can produce good science. An obvious example of the first is Rachel Carson (see **Box 1**) who, if not the patron saint, was at least the founding mother of modern environmentalism. Her book *Silent Spring* was an inspiring account of the damage caused to our environment by the reckless spraying of pesticides, especially DDT (see **Box 2**).

Box 1

Rachel Carson 1907–1964

A biologist and writer, mainly concentrating on marine biology (*Under the Sea Wind* 1941; *The Sea Around Us* 1951; *The Edge of the Sea* 1955). She then turned her attention to the indiscriminate use of pesticides (*Silent Spring* 1962). She later commented, “We must have insect control. I do not favour turning nature over to insects. I favour the sparing, selective and intelligent use of chemicals. It is the indiscriminate, blanket spraying that I oppose.”

Box 2

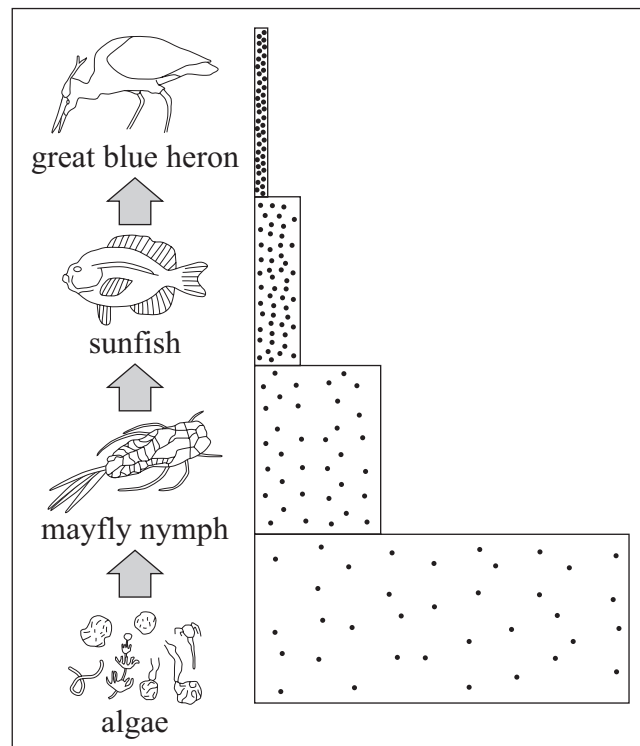
DDT is a persistent organic pesticide (**Figure 1**), a chlorinated hydrocarbon, previously widely used in agriculture. Its use in agriculture is now generally banned, but its use is still permitted to prevent insect-borne disease, mainly in Less Economically Developed Countries (LEDCs).

Attempts to reduce this use continue, but alternatives are more expensive, hence it is still widely used in LEDCs. DDT’s main problem is bioaccumulation up the food chain (**Figure 2**), leading to thinning of eggshells in birds (**Figure 3**), which readily break during the brooding period, reducing breeding success. High levels of chlorinated hydrocarbons interfere with the formation of eggshells of normal thickness. DDT residues were present in most of the food consumed in the United States from the 1940s through to the 1970s, because of the large quantities of DDT that were used on agricultural crops. DDT was retained in the body fat of people who consumed this food (**Figure 4**). There is some disputed evidence of a link to premature births.

Figure 1: Persistence of chlorinated hydrocarbon insecticides in agricultural soils

Insecticide	Years since treatment	Percentage remaining
Aldrin	14	40
Chlordane	14	40
Endrin	14	41
Heptachlor	14	16
Dilan	14	23
Isodrin	14	15
Benzene hexachloride	14	10
Toxaphene	14	45
Dieldrin	15	31
DDT	17	39

Figure 2: Diagram illustrating the process of biomagnification of a chlorinated hydrocarbon in an ecosystem



Key: The closeness of the dots indicates the concentration of the chlorinated hydrocarbon.

Turn over ▶

Figure 3: Correlation between DDE concentrations in the eggs of Alaskan falcons and hawks and reduction in the thickness of their eggshells (compared with shells collected prior to 1947). DDE is a metabolite of DDT.

Species	Location	Average concentration of DDE in eggs (ppm)*	Reduction in shell thickness
Peregrine falcon	Alaskan tundra (north slope)	889	21.7%
Peregrine falcon	Central Alaska	673	16.8%
Peregrine falcon	Aleutian Islands	167	7.5%
Rough-legged hawk	Alaskan tundra (north slope)	22.5	3.3%
Gyrfalcon	Seward Peninsula, Alaska	3.88	0

* ppm: parts per million

Figure 4: Average levels of DDT in human body fat for individuals living in the United States, 1942-1978 (ppm µg/g, fat).

Year	1942	1950	1954–56	1961–62	1962–63	1968	1970	1972	1974	1976	1978
DDT level	0	5.3	11.7	12.6	10.3	12.5	11.6	9.2	6.7	5.5	4.8

3) However, Carson also claimed that DDT caused cancer and liver damage, claims for which there is no evidence but which led to an effective world-wide ban on the use of DDT that is proving disastrous. Her motives were pure; the science was wrong. DDT is the most effective agent ever invented for preventing insect-borne disease, which, according to the US National Academy of Sciences and the World Health Organisation (WHO) prevented over 50 million deaths from malaria in about two decades. Although there is no evidence that DDT harms human health, some NGOs still demand a world-wide ban based on Carson's claims. Careless science costs lives.

4) Contrast the benefits that have resulted from the profit motive, a motive that is held suspect by the public. Multi-nationals, chief villains of anti-capitalists, have developed antibiotics, vaccines that have eradicated many diseases like smallpox and polio, genetically modified insulin for diabetics, and plants such as GM insect-resistant cotton (see **Box 3**) that have reduced the need for pesticides and so increased the income and improved the health of millions of small cotton farmers. The fact is that self-interest can benefit the public as effectively as philanthropy.

Box 3

GM cotton now accounts for 76% of US cotton production. However in other countries its trials have not always proved more successful than indigenous varieties.

5) But in the end motives are irrelevant to the validity of science. It does not matter if a scientist wants to help mankind, get a new grant, win a Nobel Prize or increase the profits of her company. It does not matter whether a researcher works for Monsanto or Greenpeace. Results are no more to be trusted if the researcher declares his values and confesses that he beats his wife, believes in God, or is an Arsenal supporter. What matters is that the work has been peer-reviewed, that the findings are reproducible and that they last. If they do they are good science. If not, they are not. Science itself is value-free. There are objective truths in science. We can now regard it as a fact that the Earth goes around the sun and that Darwinism explains the evolution of species.

6) Motives are not irrelevant, and unselfish motives are rightly admired more than selfish ones. There are numerous examples of misconduct by big companies, and we should examine their claims critically and provide effective regulation to control abuses of power and ensure the safety of their products. Equally we should not uncritically accept the claims of those who act from idealistic motives. NGOs inspired by the noble cause of protecting our environment often become careless about evidence and exaggerate risks to attract attention (and funds). Although every leading scientific academy has concluded that GM crops are at least as safe as conventional foods, this does not stop Greenpeace reiterating supposed dangers of GM foods. Stephen Schneider, a climatologist, publicly justified distortion of evidence: “Because we are not just scientists but human beings as well ... we need to ... capture the public imagination ... So we have to offer up scary scenarios, make simplified dramatic statements, and make little mention of any doubts we may have.”

7) A look at the history of science makes it evident how irrelevant the values of scientists are. Newton’s passion for alchemy did not invalidate his discovery of the laws of gravitation. To quote Professor Fox of Rutgers University: “How is it relevant to Mendel’s findings about peas that he was a white, European monk? They would have been just as valid if he had been a Spanish speaking atheist.”

Box 4

Lord Dick Taverne is the Chairman of the pro-GM lobby group Sense About Science and the author of *The March of Unreason* (March 2005). Although he has no background in science, his long career has taken in politics, the law, business, lobbying, quite apart from supporting biotechnology. Taverne and the director of Sense About Science, Tracey Brown, co-authored the article ‘Over-precautionary tales: The precautionary principle represents the cowardice of a pampered society’, *Prospect*, September 2002.

Source: adapted from DICK TAVERNE, *The Guardian*, 18 February 2005

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