Zig Zag Education

Science

Level 3 | AAQ BTEC | 610/3965/2

Course Companion

for Pearson Level 3 AAQ BTEC National in Applied Science (Extended Certificate)

Unit 6 Contemporary Issues in Science

zigzageducation.co.uk

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Contents

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Teacher's Introduction

This course companion has been written specifically for the Pearson BTEC Level 3 National Extended Certificate in Applied Science (AAQ) (first teaching from September 2025).

About Unit 6: Contemporary Issues in Science

Unit 6 (90 GLH) is assessed internally. It is 90 guided learning hours.

Unit 6 is an optional unit in the *Extended Certificate* (360 GLH).

Remember!

Always check the exam board website for new information, including changes to the specification and sample assessment material.

The theory notes and recap questions cover the essential knowledge and understanding prescribed in the BTEC Unit 6 specification (Contemporary Issues in Science). The notes are presented in specification order.

Each of the three learning aims (A–C) is given its own section in the resource. These are as follows:

A. Investigate contemporary scientific issues that impact the global population and environment.
B. Examine the effect different organisations have on contemporary science.
C. Understand how to evaluate and report scientific information.

The three *learning aims* are assessed as follows:

A. *Investigate contemporary scientific issues that impact the global population and environment.*
Students are required to investigate projects over the last 30 years and describe how they have been implemented; their effects on people and the environment, and any ethical concerns they may have raised.
B. *Examine the effect different organisations have on contemporary science.*
Students are required to identify different organisations and their influence on contemporary issues within science. They must also examine the methods used by these organisations and their effectiveness.
C. *Understand how to evaluate and report scientific information.*
Students are required to understand different types of scientific reporting and their target recipients. They must be able to examine the reliability of information and disinformation alongside source reporting and referencing. Students will also need to write articles on scientific issues that are appropriate for general and professional audiences.

Questions are interspersed throughout the guide to test and develop understanding. Mini-tasks are aimed at consolidating knowledge and understanding, whereas the skill-building activities develop the specific skills students will require in the assessment.

As activities are open response and designed to practice skills across a range of different scenarios, and to avoid providing students with templates as per BTEC guidelines, answers have not been included in this resource.

Additionally, a list of websites for further research organised by topic is provided as an appendix, teachers may wish to share some of these sites with students to get them started on their research, but should use this with caution so as to not risk offering too much additional support.

The table on the following page provides an overview of which skills are covered in which tasks, to support teacher planning.

Skill code	Skill description
A.P1	Carry out a literature search on chosen scientific developments an summarise research.
A.P2	Describe the effects of scientific developments on society.
A.P3	Describe the effects of scientific developments on the environmen
A.M1	Explain the effects of two scientific developments on society and t environment.
A.D1	Evaluate the effects of two scientific developments on society and environment.
B.P4	Describe the role of governmental and global organisations in con with contemporary scientific issues.
B.P5	Describe the role that non-governmental organisations have on contemporary scientific issues.
B.P6	Describe the role of business organisations in connection with contemporary scientific issues.
B.M2	Explain the impact that different organisations have on contempo scientific issues.
B.D2	Evaluate the impact that different organisations have on contemp scientific issues.
C.P7	Explain how a scientific issue is reported and presented for differe audiences.
C.P8	Explain how the reporting of contemporary science issues could be interpreted as valid and reliable.
C.M3	Produce an article which discusses a scientific issue for a general a using information from selected sources.
C.D3	Produce an article which evaluates a scientific issue for a professio audience, using selected sources and further research.

Learning aim A: Investigate co
scientific issues that impact t
population and environ

A1 Scientific issues

!	*Key points covered*		
• Climate change • Food security	• Health for all • Medical treatments	• C

In our ever-changing world, scientific issues play a crucial role in shaping our futur topics we're facing today:

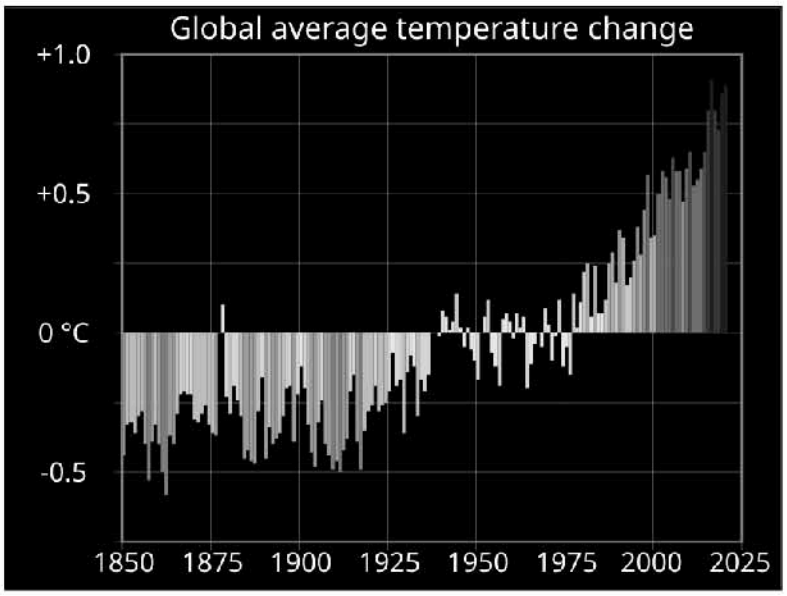
Climate change	Driven largely by human activities, climate change significantly impacts our environment. We must understand its causes and effects and take action to mitigate these changes.
Food security	Ensuring everyone has enough to eat is another critical issue. Modern farming methods, genetic modification, animal welfare, and smart land use and conservation strategies all play a part in securing our food supply for the future.
Clean energy	Transitioning to clean energy is essential for reducing our carbon footprint. This includes the use of lithium batteries in electric cars, harnessing the power of wind and solar energy, exploring nuclear power and nuclear fusion, and utilising hydroelectric power.
Health for all	Achieving health for everyone involves tackling inequalities, advancing regenerative medicine and stem cell therapy, promoting health through vaccination and healthy behaviours, and preparing for future pandemics.
Medical treatments	Innovative medical treatments are transforming healthcare. These include proton beam therapy, stem cell therapy, genetic engineering, and advanced prosthetics, all of which offer new hope for treating various conditions.

By understanding these scientific issues and working towards solutions, we can cre future for all.

Climate change

Anthropogenic causes and effects

Climate change refers to significant changes in global temperatures and weather p
change occurs naturally, recent changes are largely due to **anthropogenic** (human
burning of **fossil fuels** and deforestation. These activities release **greenhouse gas**
methane into the atmosphere, trapping heat and causing the planet to warm.



The burning of fossil fuels and deforestation are two major human activities that si
change by increasing the concentration of greenhouse gases in the atmosphere.

Mini-task

What are the main anthropogenic causes of climate change?

Burning of fossil fuels

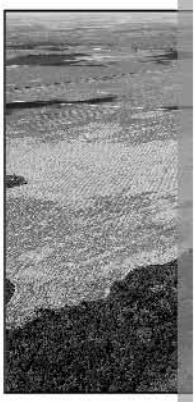
Fossil fuels such as coal, oil, and natural gas are burned for energy in power plants,
This combustion process releases large quantities of carbon dioxide (CO_2) and met
potent greenhouse gases.

1. **Carbon dioxide (CO_2):** When fossil fuels are burned, carbon stored in these fu
air to form CO_2. This gas is a significant contributor to the greenhouse effect b
lifetime, meaning it can remain in the atmosphere for hundreds of years, conti
2. **Methane (CH_4):** Although methane is released in smaller quantities compare
effective at trapping heat, making it a more potent greenhouse gas on a per m
emissions come from natural gas production, livestock digestion, and the deca

Deforestation

Deforestation, the clearing or thinning of forests by humans, also plays a crucial rol

1. **Carbon storage:** Trees and forests act as carbon sinks, absorbing CO_2 from the atmosphere during the process of photosynthesis and storing it in biomass (trunks, branches, roots and leaves). When forests are cleared, not only is this carbon sequestration capability lost, but the carbon stored in the trees is released back into the atmosphere as CO_2 if the wood is burned or left to decay.
2. **Soil carbon release:** Forest soil also stores significant amounts of carbon. When forests are cut down, the disturbance to the soil can release this stored carbon as CO_2.



Mechanism of the greenhouse effect

1. **Absorption of infrared radiation:** Greenhouse gases in the atmosphere, such infrared radiation emitted by the Earth's surface. Normally, this radiation would greenhouse gases trap some of this heat, causing the atmosphere to warm.
2. **Radiation re-emission:** These gases then re-emit the absorbed heat in all dire the Earth's surface. This additional heat further warms the surface, leading to the greenhouse effect.

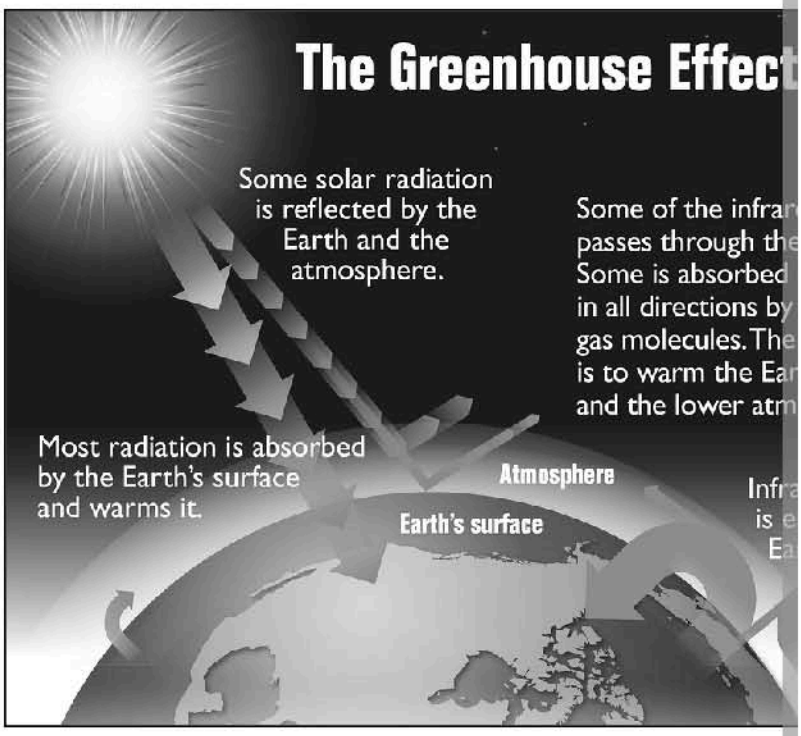
Impacts on global warming

1. **Temperature increase:** The enhanced greenhouse effect leads to an increase phenomenon known as global warming. Even small increases in average glob significant impacts on climate patterns.
2. **Climate change:** The warming of the planet leads to broader changes in clima sea levels, and ecosystems. This includes more frequent and severe weather e droughts, and heavy rainfall.
3. **Biodiversity loss:** As temperatures rise and habitats change, many species ma a loss of biodiversity. This can disrupt ecosystems and the services they provid of crops and regulation of water cycles.

Mini-task

Describe **two** major effects of climate change on the environment.

Understanding the role of human activities, such as the burning of fossil fuels and c to climate change is crucial for developing strategies to mitigate their impact. By re emissions and protecting forests, we can help stabilise the climate and reduce the r global warming.



Measures to mitigate change

To combat climate change, we must reduce greenhouse gas emissions. This can be achieved through various strategies:

- **Renewable energy:** Using energy sources such as wind, solar, and hydroelectric power that do not emit greenhouse gases.
- **Biofuels:** Fuels made from organic materials that can replace fossil fuels.
- **Carbon capture:** Technologies that capture and store carbon dioxide (CO_2) emissions from sources such as power plants and industrial processes before they can enter the atmosphere. The process involves three main steps: capture, transport and storage. During the capture phase, CO_2 is separated from other gases produced in industrial activities using various methods such as pre-combustion capture, post-combustion capture, and oxy-fuel combustion. Once captured, the CO_2 is compressed and transported, typically through pipelines, to suitable storage sites. These sites are often deep underground geological formations such as deplet saline aquifers, where the CO_2 can be securely stored for long periods. This te reducing greenhouse gas emissions and mitigating climate change, particular to decarbonise.

Measures to reach carbon neutrality

Achieving **carbon neutrality** means balancing the amount of carbon dioxide emitted with the amount removed from the atmosphere. This can be done by:

- Switching to non-carbon energy sources
- Increasing the use of renewable energy
- Implementing biofuels and carbon capture technologies

Measure	Individual scale	Local scale
Switching to non-carbon energy sources	• Individuals can switch to electric vehicles (EVs) and use electric appliances instead of gas. • Opting for renewable energy plans if available.	• Local governments can invest in public EV charging infrastructure and promote public transportation. • Encouraging community-wide shifts to non-carbon energy solutions, such as solar panels for homes.
Increasing the use of renewable energy	• Installing solar panels or small wind turbines on homes. • Using renewable energy providers.	• Local municipalities can build solar farms or wind farms. • Providing incentives for businesses and homes to switch to renewables.
Implementing biofuels and carbon capture technologies	• Individuals can support biofuel use by choosing biofuel options for heating or transport where available.	• Local industries can adopt biofuels for machinery and heating. • Local governments can invest in carbon capture technologies for local power plants.

This table highlights the actions that can be taken at different scales to help achiev varying levels of impact and feasibility depending on the scope of implementation.

Mini-case study

Countries such as Sweden and Costa Rica are paving the path towards carbon ne
strategies and ambitious targets to reduce greenhouse gas emissions and promo

Sweden's approach:
Sweden has set a bold goal to become one of the world's first fossil-free welfare
aims to achieve net zero greenhouse gas emissions, primarily by transitioning to
as hydropower, wind power, and bioenergy. Initiatives include extensive investme
infrastructure, incentives for electric vehicles (EVs), and stringent regulations on c
industries and households. This comprehensive approach has positioned Sweden
sustainable development and climate action.

An offshore wind farm.

Costa Rica's success story:
Costa Rica has made remarkable strides towards carbon neutrality, leveraging its
The country derives over 99% of its electricity from renewable sources, primarily h
geothermal energy. Through robust policies and initiatives, Costa Rica has not on
but also preserved its rich biodiversity and ecosystems. The government's commi
with investments in renewable energy projects and sustainable practices, has gar
serves as a model for other nations striving for environmental sustainability.

Cachi Hydroelectric Plant, Cachi, Province of Cartago, Costa Ri

Impact and lessons learned:
Both Sweden and Costa Rica demonstrate that achieving carbon neutrality is feas
planning, and public engagement. Their success underscores the importance of in
into national energy policies, fostering innovation in technology and infrastructur
businesses in sustainable practices.

Mini-task

- Define carbon neutrality and provide an example of a country working towa
- How can urban areas effectively transition to carbon neutrality?

Skill-based question

1 Describe how reforestation projects are implemented to combat climate
Use specific examples covered in this unit, of reforestation initiatives in s

Tips: **Step 1:** Define reforestation and its role in climate change mitigation.
Step 2: Research reforestation projects in two countries (e.g. Brazil and
Step 3: Use the table below to organise your findings:

Country	Reforestation project name	Steps taken

Step 4: Write a short paragraph summarising how reforestation is carrie
specific examples.

Food security

Modern farming methods

Modern farming techniques play a crucial role in meeting the food demands of a b
Two key methods at the forefront of this effort are precision agriculture and hydro

Precision agriculture employs advanced technologies such as GPS, sensors and drones to monitor and manage crop growth, soil conditions and environmental variables. By precisely applying inputs like water, fertilisers and pesticides only where and when they are needed, farmers can optimise yields, reduce resource wastage, and minimise environmental impacts such as water **pollution** and soil degradation. This approach not only enhances crop productivity but also promotes sustainable farming practices.

Drones equipped with modified cameras use NIR (Near Infrare photography to map plantations and monitor plant health effecti

Mini-task

Explain the importance of precision agriculture in modern farming.

Hydroponics, on the other hand, involves growing plants without soil, instead usin
Plants are typically grown in a controlled environment, such as greenhouses or ver
factors such as temperature, humidity and light can be carefully regulated. Hydro
efficiency and water use, making them suitable for urban agriculture and areas wit
method allows for year-round cultivation, reduces the use of pesticides, and can p
traditional soil-based farming.

Aquaponics greenhouse in Brooks, Alberta.

These modern techniques are integral to addressing global food security challenge
efficiency, sustainability and resilience in the face of climate change.

Mini-task

Name **two** modern farming methods that contribute to food security.

Genetic modification

Genetic modification (GM) involves the precise alteration of an organism's DNA t
achieve desirable traits. In agriculture, this technology is used to engineer crops wi
enhanced characteristics such as improved yield, resistance to pests and diseases, a
increased nutritional value.

Techniques like CRISPR-Cas9 and gene splicing enable scientists to introduce or m
plant's genome. For example, genetically modified crops can be engineered to wit
conditions, reduce the need for chemical pesticides, or increase the nutrient conte

While GM crops have the potential to significantly boost food security by increasin
reducing food shortages, they also spark debates about their long-term environme
health risks. Concerns include the possibility of unintended consequences on non-
development of resistant pest species, and the ethical implications of modifying ge

Mini-task

What are some ethical concerns associated with genetic modification in agricultu

Animal welfare

Ensuring humane treatment of animals in agriculture is a fundamental aspect of et
This involves providing animals with adequate living conditions that meet their phy
Key components include ensuring sufficient space, proper nutrition, and access to

Humane handling practices are essential to reduce stress and discomfort during transportation, housing, and routine procedures. Additionally, farm animals should be protected from extreme weather conditions and given opportunities for natural behaviours.

Welfare standards are often regulated by national and international guidelines, such as those outlined by the RSPCA and the World Organisation for Animal Health (WOAH). Adhering to these standards not only improves animal health and productivity but also addresses ethical concerns and consumer expectations regarding animal rights.

Land use and conservation

Balancing agricultural land use with environmental conservation is essential to prot
biodiversity. Sustainable agricultural practices are designed to optimise land produ
environmental impact. Techniques such as crop rotation, which involves alternatin
same field to improve soil health and reduce pest build-up, are vital for maintainin
reliance on chemical inputs.

Agroforestry integrates trees and shrubs into crop and livestock systems, enhancin
structure, and providing additional income sources. Additionally, conserving wildli
landscapes helps to preserve ecological balance and supports species conservation
helps to ensure that agriculture can meet current food demands without comprom
for future generations.

Agroforestry in Masake, Uganda.

Mini-case study

The introduction of genetically modified organisms (GMOs) in agriculture has led to increased crop yields and reduced pesticide use. For example, Bt corn, which is genetically modified to resist pests, has significantly decreased the need for chemical pesticides.

An empty seed bag for corn containing three patented genes that make it resistant to herbicides.

Skill-based question

2 Find and evaluate three reliable sources that discuss strategies to improv

Tips: **Step 1:** Search for articles, reports or websites on food security strategi or trusted organisations (e.g. FAO, WHO).
Step 2: Complete the table below to evaluate the reliability of each sou

Source name	Type (e.g. article, report)	Publisher	Evidence of re (e.g. citations, pee

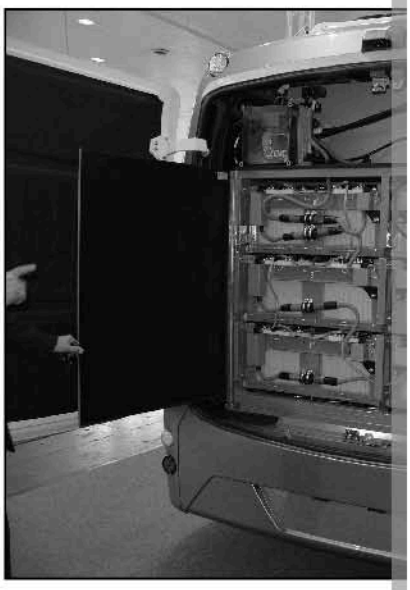
Step 3: Based on your evaluation, explain which source is most reliable, strategies discussed in that source.

Clean energy

Lithium batteries in electric cars

Electric vehicles (EVs) are powered by **lithium-ion batteries**, which store and release energy through electrochemical processes. These batteries are crucial for reducing emissions from the transportation sector as they enable vehicles to operate without internal combustion engines, which are major sources of greenhouse gases. Lithium-ion batteries offer high energy density and efficiency, contributing to longer driving ranges and shorter charging times for EVs, making them a key technology in the shift towards sustainable transportation.

Lithium-ion batteries – batteries that power electric vehicles.



Lithium-ion batteries

Mini-task

How do lithium-ion batteries help in reducing carbon emissions from transportat

Wind turbines in southern California.

Wind power

Wind turbines co
wind into mecha
transformed into
generator. Wind
energy source th
on fossil fuels, th
emissions. Mode
substantial amou
installed both on
wind energy a ve
clean energy pro

Solar power

Solar panels, or photovoltaic (PV) systems, capture sunlight and convert it into electricity through the photovoltaic effect. Solar power is a pivotal player in the transition to renewable energy, offering a sustainable and abundant energy source. Solar energy systems can be deployed on various scales, from small residential rooftops to large solar farms, contributing to energy security and reducing the carbon footprint associated with electricity generation.

Mini-task

Compare and contrast wind power and solar power as renewable energy sources.

Nuclear power and fusion

Nuclear power generates electricity through nuclear fission reactions, where atom
nuclei are split to release energy. It produces large amounts of energy with minim
greenhouse gas emissions but poses challenges such as the management of radioa
waste and the potential for catastrophic failures.

A nuclear power plant in Belgium.

Nuclear fusion, a pot
to replicate the Sun's
fusing atomic nuclei.
clean energy with few
safety and waste disp
issues compared to fi
though it remains in t
experimental stage.

Mini-task

Compare the pote
disadvantages of

Hydroelectric power

Hydroelectric power generates electricity by harnessing the energy of flowing or falling water. It is a reliable and renewable energy source that can provide consistent power supply, making it a cornerstone of many national energy grids. However, hydroelectric projects can have significant environmental impacts, such as altering water ecosystems and displacing local communities. Despite these challenges, hydroelectric power remains a vital part of the global renewable energy mix.

The Three Gorges Dam, C
facil

Mini-case study

Norway is widely recognised as a global leader in sustainable energy production. generated from hydroelectric power, making it one of the most renewable-based world. Hydroelectric power is Norway's main renewable energy source, harnessin from rivers, lakes and waterfalls to generate electricity. This process produces mi emissions, resulting in a very low environmental impact compared to fossil fuels. clean, renewable source, Norway has made significant strides towards carbon neu its carbon footprint across sectors. This strategic investment in hydropower not o domestic energy needs but also strengthens its position as a global role model fo transition to greener energy systems. Norway's long-standing commitment to su benchmark for climate-conscious innovation and environmental stewardship.

Hensfossen Dam, Norway.

Skill-based question

3 Summarise the main points of a case study on Norway's use of hydroelec energy production.

Tips: **Step 1:** Read the case study provided. Identify the main aspects of Norwa
Step 2: Use the table below to organise your findings:

Key aspect	Details
Percentage of electricity generated	
Main renewable energy source	
Environmental impact	
Contribution to carbon neutrality	
Global leadership in energy	

Step 3: Write a summary (100–150 words) using the information from t
- Norway's reliance on hydroelectric power.
- The environmental benefits of this energy source.
- Its role as a global leader in sustainable energy.

Health for all

Inequalities

Health inequalities are disparities in health status and access to healthcare that exist between different groups within a population. These inequalities can be influenced by a range of socio-economic factors including:

- **Income:** Individuals with higher incomes often have better access to healthcare services, healthier living conditions, and improved overall health compared to those with lower incomes. Financial resources enable access to private healthcare, higher-quality nutrition, and wellness services.
- **Education:** Higher levels of education are associated with better health outco are more likely to engage in health-promoting behaviours, have better health preventative care.
- **Geography:** Geographic location can significantly impact access to healthcare or remote areas often face challenges such as fewer healthcare facilities, longe and shortages of healthcare professionals.

Understanding these factors is crucial for addressing health disparities and ensurin equitable access to necessary health resources and services.

Mini-task

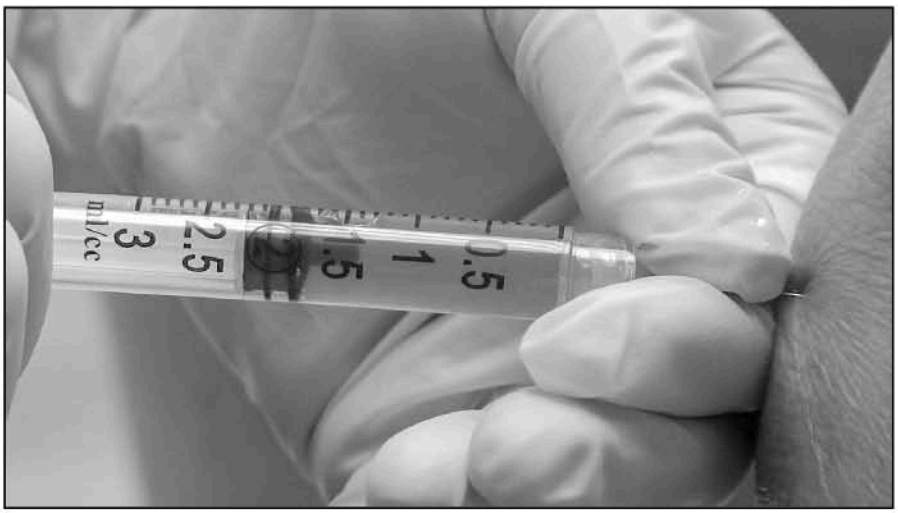
Explain the concept of health inequalities and provide an example.

Regenerative medicine and stem cell therapy

Regenerative medicine is a rapidly advancing field focused on repairing or replacing damaged tissues and organs to restore normal function. This field encompasses several techniques:

- **Stem cell therapy:** This involves the use of **stem cells** – undifferentiated cells with the potential to develop into various types of cells – to treat or prevent diseases. Stem cells can be derived from various sources, including embryonic tissues and adult tissues like bone marrow. These cells are used to regenerate damaged tissues, such as in cases of spinal cord injuries, heart disease, and certain types of cancer.
- **Tissue engineering:** This involves creating biological substitutes that can restore, maintain or improve tissue function. It combines cells, scaffolds and growth factors to develop new tissues or organs.
- **Gene therapy:** A related area where genetic material is introduced into a patie disease. It can be used to correct genetic defects or enhance the body's abilit

These advancements offer significant potential for treating conditions that currentl effective treatments.



Stem cells being injected into the knee of a patient.

Health promotion

Health promotion focuses on encouraging behaviours and conditions that enhance overall well-being and prevent disease. Key strategies include:

- **Vaccination**: Immunisation is a critical component of public health, helping to prevent the spread of infectious diseases such as measles, flu and COVID-19. Vaccines work by stimulating the immune system to fight s
- **Healthy eating**: Promoting balanced diets rich in fruits, vegetables, whole gra prevent chronic diseases such as obesity, diabetes, and heart disease.
- **Exercise**: Regular physical activity is essential for maintaining good health. It reduces the risk of many diseases, improves mental health, and supports overall well-being.
- **Education on harmful behaviours**: Raising awareness about the risks associated with smoking, excessive alcohol consumption, and drug abuse is vital for preventing related health issues. Education campaigns and public health initiatives aim to reduce the prevalence of these behaviours and their associated health impacts.

Preparing for pandemics

Pandemic preparedness involves a series of strategies and measures to manage and mitigate the impact of widespread infectious diseases.
Key components include:

- **Healthcare infrastructure**: Strengthening healthcare systems to handle surge in patient numbers, including building capacity in hospitals, training healthcar workers, and ensuring the availability of essential medical supplies.
- **Vaccine development**: Rapid development and distribution of vaccines are cr Research and production must be accelerated to provide effective vaccines an
- **Public health measures**: Implementing measures such as social distancing, m protocols helps to reduce the spread of infectious diseases. Public health cam how to protect themselves and others during a pandemic.
- **Global coordination**: Effective pandemic response requires international colla resources and strategies. Organisations like the World Health Organization (W coordinating global efforts and providing guidance.

Mini-task

How did the COVID-19 pandemic highlight the need for better pandemic prepare

Mini-case study

The COVID-19 pandemic underscored the critical importance of pandemic prepar countries with robust healthcare systems and rapid vaccine development capabili spread more effectively.

For instance, New Zealand and the United States adopted markedly different approaches with varying outcomes. New Zealand implemented strict lockdowns and extensive contact tracing early on, resulting in a lower infection rate and fewer deaths. As of July 2021, New Zealand reported around 2,800 cases and 26 deaths, with an **R-value** consistently below 1, indicating the virus was not spreading widely.

R-v the on dis ev

Conversely, the United States faced challenges with inconsistent lockdown measures and delayed vaccine rollout in the initial stages, leading to a significantly higher number of infections and deaths. By the same period, the US had reported over 33 million cases and more than 600,000 deaths, with R-values fluctuating due to varying levels of public health measures across states. This comparison highlights the impact of preparedness and coordinated responses in managing pandemic outcomes, providing valuable insights for future public health strategies.

Infographic from the Public Health Agency of Sweden: 'Protect yourself and others from infection', regarding COVID-19

Skill-based question

4 Create a properly formatted Harvard-style reference list for the followin universal healthcare:

1. An academic journal article.
2. A report from the World Health Organization (WHO).
3. A book on public health policy.

Tips: **Step 1:** Research and collect the details for each source (e.g. author, titl
Step 2: Use the table below to organise the required elements for Harv

Source type	Author(s)	Title	Publisher/Journal
Journal article			
WHO report			
Public health book			

Step 3: Write the references using the Harvard style. For example:
Smith, J., 2020. *Universal Healthcare Policies*. London: Health Publications.

Links to online guides for Harvard referencing:

zzed.uk/12837-Harvard-1
zzed.uk/12837-Harvard-2

Medical treatments

Proton beam therapy

Proton beam therapy is a cutting-edge form of radiation therapy that utilises protons, rather than traditional X-rays, to target and destroy cancer cells. Protons are positively charged particles that can be directed precisely to the tumour site.

One of the major advantages of proton beam therapy is its ability to deposit most of its energy directly at the tumour, a phenomenon known as the Bragg peak. This means that protons deliver high doses of radiation to the cancerous tissue while sparing the surrounding healthy tissues and organs from unnecessary radiation damage. This precision can significantly reduce side effects and improve outcomes, particularly in treating tumours located near critical structures or in paediatric patients where long-term effects need to be minimised.

The Varian TrueBeam is a precise and fa

Mini-task

What are the benefits of proton beam therapy compared to traditional radiation t

Stem cell therapy

Stem cell therapy involves the use of stem cells to repair or regenerate damaged tissues and organs. Stem cells are undifferentiated cells with the unique ability to develop into various types of cells and tissues.

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This therapy has shown promise in treating a wide range of conditions, including sp
cells may help to repair damaged nerve tissues; heart disease, by regenerating dam
diabetes, by potentially restoring insulin-producing cells in the pancreas.

Advances in stem cell research continue to expand the scope of possible treatment
regenerative medicine.

Genetic engineering

Genetic engineering, also known as genetic modification, involves altering the DN
of an organism to treat or prevent diseases. Techniques such as CRISPR-Cas9 have
revolutionised this field by enabling precise editing of the genome.

CRISPR allows scientists to make targeted changes to DNA sequences, correcting g
inherited diseases, or introducing new genetic material to enhance cellular functio
applications in treating genetic disorders such as cystic fibrosis, muscular dystroph
The ability to modify genes at a molecular level holds significant promise for perso
therapeutic options.

Mini-task

Describe two ways in which genetic engineering can be used in medical treatmen

Prosthetics

Modern **prosthetics** are sophisticated artificial limbs designed to restore functionality and improve the quality of life for individuals who have lost limbs.

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for

Unlike traditional prosthetics, advanced models often incorporate technologies suc
detect electrical signals from the muscles, allowing the user to control the prosthet
Some prosthetics are even equipped with brain-computer interfaces (BCIs) that ena
artificial limbs through neural signals, offering a more intuitive and natural way of m

These advancements in prosthetic technology aim to enhance mobility, dexterity, a
individuals regain independence and improve their daily lives.

*The Modular Prosthetic Limb (MPL) developed by John Hopkins Applied Phy
with Walter Reed National Military Medical Center and the Uniformed Services Univers*

Mini-case study

Advances in prosthetic technology have enabled athletes with prosthetic limbs to
Games, showcasing their incredible capabilities and resilience.

Marlou van Rhijn, a retired Dutch sprinter born without lower legs, is a world record holder i

Mini-task

Describe how modern prosthetics are enhancing the lives of individuals with limb

Skill-based question

5 **Describe** what genetic engineering is and a technique commonly used in
how this technique can be used to treat genetic disorders and improve p

A2 Implications of scientific issues

Key points covered

- Social
- Economic
- Environmental
- Ethical

When we talk about the implications of scientific issues, we're exploring how scient challenges affect different aspects of our lives. These implications can be grouped

Social implications	Economic implications	Ethical implication
These refer to how scientific issues influence the way people interact with each other and society. This can include improvements or problems in health, employment, education, travel and communication.	This area looks at how science affects the economy, such as the production, distribution and trade of goods and services. It also involves how supply and demand are influenced, and the broader economic impact on both a large (**macroeconomic**) and small (**microeconomic**) scale. Additionally, it considers income, spending and investment related to scientific developments.	Here, we examine the moral values and belie of individuals regardin scientific issues. This includes debating wha right or wrong and considering conflicts th arise between science and other influences li politics, medicine, law, religion, society, and th economy.
		

Macroeconomic – the branch of economics that studies large-scale factors affecting a country's economy, such as national income, unemployment, inflation, and economic growth.

Microeconomic – the branch of economics that studies individual households, businesses, and markets, focusing on supply, demand, and decision-making at a smaller scale.

Biotic – refers to ecosystem, inclu microorganisms.

Abiotic – non-liv of the environme and the functioni

By understanding these different implications, we can better grasp the complex eff our world.

Scientific advancements and issues impact our world in many ways. Understanding comprehending the full scope of scientific progress. This section delves into the so environmental implications of scientific issues. Each area helps us appreciate how s aspects of life.

Social implications

Scientific issues can profoundly influence the **interaction** between individuals and groups, leading to improvements or deterioration in social factors such as health, employment, education, travel and communication.

Health

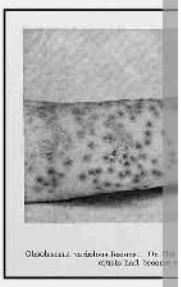
Scientific progress, particularly in medicine, can dramatically improve public health diseases. The development of vaccines and new medical treatments exemplifies th development of COVID-19 vaccines has significantly reduced the pandemic's impa allowed societies to return to normality more quickly.

Mini-task

How has the development of vaccines impacted global health?

Mini-case study

The eradication of smallpox, declared in 1980, is one of the greatest achievements in public health, saving an estimated 5 million lives annually.



Employment

Scientific progress has created new job opportunities while also transforming or eliminating traditional roles. This can lead to both social benefits and challenges.

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Technological advancements and automation

With the rise of **automation** – the use of technology to perform tasks without human intervention – many industries have improved efficiency and productivity. For example, robots are now widely used in manufacturing to perform repetitive tasks, while **artificial intelligence (AI)** is automating **data analysis** in fields like finance and healthcare.

Mini-case study

The retail sector has seen significant automation through the introduction of self-checkout systems. While these technologies reduce wait times for customers, they also replace traditional cashier roles, leading to job displacement. According to a report by the World Economic Forum (2021), automation may displace 85 million jobs globally by 2025 but also create 97 million new roles in areas such as AI, robotics, and renewable energy.

STEM jobs

Advancements in science and technology have increased demand for **STEM jobs** (science, technology, engineering and mathematics). Roles such as data analysts, renewable energy engineers, and biotechnology researchers are in high demand as industries adapt to new scientific discoveries.

Mini-task

Identify two careers that have emerged due to scientific advancements. Describe how these roles contribute to society.

Education

Technological advancements driven by science have transformed education, making it more accessible and efficient. **Online learning platforms** and digital resources enable students to access educational materials from anywhere in the world, breaking down geographical barriers. However, this shift has also highlighted the **digital divide** – the gap between those who have access to modern information and communication technology and those who do not.

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Mini-case study

During the COVID-19 pandemic, many schools and universities shifted to online l kept education going but also highlighted the digital divide, as students without Internet faced significant challenges.

Travel

Science has revolutionised the way we travel, making transportation faster, safer, a

High-speed rail and electric vehicles (EVs)

High-speed rail systems like Japan's Shinkansen and advancements in **electric vehicles (EVs)** are examples of how science has transformed travel. High-speed trains allow people to commute quickly between cities, reducing travel time and improving productivity. EVs, powered by renewable energy sources, aim to reduce greenhouse gas emissions and dependency on fossil fuels.

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Electric ve
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engine, oft

Mini-case study

Nissan, one of the pioneers in electric vehicle (EV) development, helped bring EVs into the mainstream with the launch of the Nissan LEAF – one of the world's best-selling electric cars. As of 2023, EVs made up 14% of all new car sales globally, highlighting the growing demand for cleaner, more sustainable travel options. This shift has been supported by continuous advancements in battery technology, which have improved the range, performance and affordability of electric vehicles, making them more accessible to everyday consumers. Nissan's commitment to innovation and environmental responsibility positions it as a key player in the global transition to low-emission transport.

Nissa

Space exploration and tourism

Innovations in space travel have opened new possibilities for transportation. Companies like SpaceX and Blue Origin are developing reusable rockets to make space exploration and even **space tourism** more accessible.

Mini-task

Research a recent advancement in transportation technology (e.g. electric aircraft
Explain how it could impact travel in the future.

Communication

Advances in communication technology have transformed how people share infor

The Internet and mobile technology

The **Internet**, combined with mobile technology, has created a globally connected world. Innovations such as **5G networks** enhance Internet speed and connectivity, enabling activities such as video conferencing, streaming, and instant messaging in real time. Social media platforms have also revolutionised how people interact, share news, and access information.

Internet – a glob
and devices, ena
information.

5G network – th
technology, offer
connectivity com

Mini-case study

During the COVID-19 pandemic, platforms like Zoom and Microsoft Teams becam
and online education. These technologies allowed millions of people to stay conn
distancing measures, showcasing the importance of robust communication syste

Artificial intelligence in communication

Artificial intelligence (AI) has transformed communication through tools like chatbo
personalised recommendations. For example, AI-powered virtual assistants (e.g. Si
tasks such as setting reminders, playing music, and answering questions.

Mini-task

List two ways 5G technology improves communication. Provide examples of how
business operations.

Skill-based question

6 Explain the causes and effects of the digital divide in society and its implic scientific advancements.

Tips: **Step 1:** Identify the main causes of the digital divide (e.g. lack of infrastructur
Step 2: Discuss the effects on access to education, healthcare, and empl
Step 3: Use the table below to organise your findings:

Cause	Effect	
Lack of infrastructure		
Social and economic differences		

Step 4: Write a short paragraph explaining the relationship between the digital divide, including specific examples.

Economic implications

Scientific advancements significantly impact the **economy** through the production, distribution and trade of goods and services, as well as affecting supply and demand, income, expenditure, and investment.

Production and distribution

Technological innovations can enhance production efficiency and the distribution of goods. For example, **automation** in manufacturing has led to increased **productivity**, reduced costs, and transformed how goods are produced and distributed.

Mini-case study

The introduction of assembly lines by Henry Ford in the early twentieth century revolutionised the automotive industry, making cars more affordable and accessible.

Henry and Clara Ford in his first car,

Mini-task

Investigate how automation has impacted manufacturing industries.

Supply and demand

Scientific developments can create new markets and change existing ones. The ris
technologies, such as solar and wind power, has shifted demand away from fossil f
global economies.

Mini-case study

The electric vehicle (EV) market is a prime example of how scientific innovation is
landscapes. Companies like Tesla have pushed the boundaries of battery techno
demand for electric cars and a decline in traditional petrol vehicle sales.

Mini-task

What economic changes have been driven by the rise of renewable energy techn

Mini-case study

The renewable energy sector is one of the fastest-growing industries globally. In
Renewable Energy Agency (IRENA) reported that over 12 million people were em
jobs worldwide, with significant growth in countries such as China and the United
employment demonstrates how scientific advancements can directly contribute t

Income

Scientific innovations often lead to the creation of new industries and job opportu
individuals and businesses. However, some industries may decline, leading to eco

Emerging industries

Scientific discoveries often give rise to new industries. For example, advancements in **renewable energy** technology have created jobs in solar panel manufacturing, wind farm construction, and energy storage. These roles contribute to economic growth and reduce reliance on fossil fuels.

Mini-task

Research a scientific advancement that has led to the creation of new job roles. Identify how this innovation has impacted income for individuals and businesses.

Expenditure

Scientific advancements influence expenditure by changing how money is spent o
infrastructure. These changes can occur at the personal, corporate or governmenta

Consumer spending

New technologies often lead to changes in consumer behaviour. For example, smartphones and **wearable devices** have become essential tools for communication and health monitoring, increasing **consumer spending** on technology.

Wearable de
body, such as
functionality li

Consumer sp
households o

Mini-case study

Apple's wearable device market has grown significantly, with products like the Ap
$50 billion global market for wearable devices in 2023. This trend reflects how ad
drive consumer spending and create new economic opportunities.

Government spending

Governments often allocate funds for scientific research and development (R&D), e
technology. This spending not only advances knowledge but also creates infrastru

Mini-case study

During the COVID-19 pandemic, governments worldwide spent billions on vaccine development. The US government's Operation Warp Speed allocated $18 billion for vaccine research, which helped pharmaceutical companies like Pfizer and Moderna produce life-saving vaccines in record time.

Mini-task

Predict how the advancement of electric vehicles might affect government or co
with a justification.

Tips: Step 1: Understand the key terms

- **Advancement of electric vehicles (EVs)**: Includes improvements in technol
  and more widespread adoption.
- **Government spending**: Money spent by the state on infrastructure, incenti
- **Consumer spending**: How much and where people spend their own money

Step 2: Consider how governments might spend

Think about:

- Investment in **charging infrastructure** (e.g. public charging points).
- **Incentives/subsidies** for EV purchases (e.g. grants or tax reductions).
- Reduced income from **fuel taxes** as fewer people buy petrol/diesel.
- Increased funding for **green energy research or manufacturing**.

Step 3: Consider how consumers might spend

Think about:

- **Initial cost** of buying an EV (often higher than traditional cars).
- **Long-term savings** (e.g. lower fuel and maintenance costs).
- Costs for **home charging installations**.
- Insurance, battery replacements, or new features like smart apps.

Step 4: Make a prediction

Use phrases like:

- 'It is likely that...'
- 'In the future, consumers may choose to...'
- 'Governments might invest more in...'

Step 5: Justify your answer

Back up your prediction with logic or real examples:

- 'For example, the UK government announced £1.6 billion in funding for EV i
- 'Since EVs are cheaper to run, consumers may save money in the long term.'

Investment

Investment in science and technology drives innovation and long-term economic growth. Both public and private sectors contribute significantly to these investments.

Investm
resource
expectati

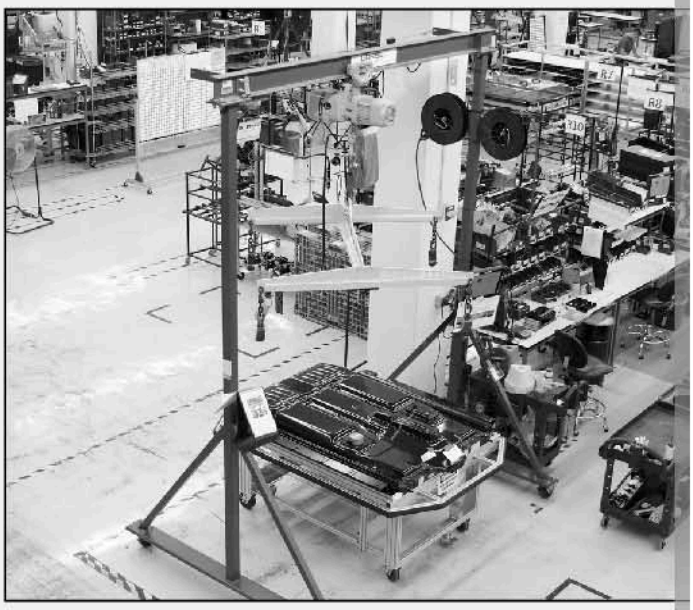
Infrastru
organisat
operation
and comm

Private investment

Private companies often invest in scientific research to stay competitive. For example, the electric vehicle (EV) industry has attracted billions in investment for battery technology and charging **infrastructure**.

Mini-case study

Tesla's investment in battery technology has revolutionised the EV market. In 202
$1 billion to research and develop next-generation batteries. This investment not
performance but also reduces costs, making EVs more accessible to consumers.



Manufacturing floor inside Tesla Motors headquarters, in Palo Alto C

Public investment

Governments invest in scientific advancements to address societal challenges. For
renewable energy projects help combat climate change while boosting local econo

Mini-case study

The European Union's Green Deal allocated €1 trillion for climate-related projects
renewable energy, sustainable agriculture, and green technology. This initiative su
a low-carbon economy and creates new economic opportunities.

Mini-task

Scientists at the Environment Agency work with universities and other scientific o
investigate environmental problems and solutions. Its research is published publi
include flooding, pollution, climate change and drought. Explain how this investm
growth or innovation.

Skill-based question

7 Evaluate the benefits and drawbacks of transitioning to renewable energy and solar power.

Tips: **Step 1:** Research the benefits (e.g. reduced emissions, job creation) and costs, dependence on weather).
Step 2: Use a table like the one below to compare benefits and drawbac

Aspect	Benefit	
Environmental		
Economic		
Energy reliability		

Step 3: Write an evaluation paragraph, weighing the benefits and drawba aspect has the greatest impact overall.

Ethical implications

Ethical implications concern the **values** and **beliefs** held by individuals and society about what is right and wrong. Scientific issues often raise ethical questions and can lead to conflicts with other societal influences such as politics, medicine and religion.

Values that are by indiv

Beliefs certain without

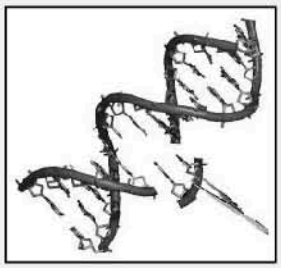
Cloning genetic cell, tiss

Rights and wrongs

New scientific developments often spark ethical debates. For instance, genetic engineering and **cloning** raise questions about the extent to which humans should interfere with natural processes and the potential long-term consequences.

Mini-case study

The first genetically modified organism (GMO) was created in 1973, and since the of intense ethical debate regarding their safety and impact on the environment.



Conflicts with other influences

Scientific issues can conflict with political, legal and religious beliefs. For example, **stem cell research**, which has the potential to treat a range of diseases, is controversial because it involves the use of human **embryos**.

Stem cell resea using stem cells medical conditio

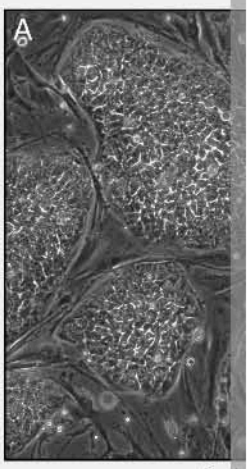
Embryo – an ea multicellular orga to the first eight

Mini-task

- What are some ethical concerns associated with genetic engineering?
- How can political decisions impact scientific research?

Mini-case study

In 2001, the US government restricted federal funding for stem cell research due to ethical concerns. This decision slowed down scientific progress in this field until the restrictions were eased in 2009, highlighting the impact of political and ethical considerations on science.



Emb

Skill-based question

8 Describe how genetic engineering techniques, such as CRISPR-Cas9, are and explain the ethical implications of these applications.

Tips: **Step 1:** Research how CRISPR-Cas9 works (e.g. cutting DNA to insert
Step 2: Use the table below to describe the steps of the process and pr

Step in the process	Description	
Identify target gene		
Modify the DNA		
Test and apply		

Step 3: Discuss the ethical concerns, such as biodiversity loss and food s

Environmental implications

Scientific issues also impact the **environment**, affecting both living (**biotic**) and non-living (**abiotic**) elements. These impacts can be local or global in scale, influencing natural and developed environments.

Natural and developed environments

Scientific advancements can lead to both positive and negative environmental changes. While technologies like renewable energy can reduce pollution, industria activities can lead to **habitat destruction** and climate change.

Mini-case study

The Great Pacific Garbage Patch, a massive accumulation of plastic waste in the ocean, is a stark reminder of the environmental impact of human activity.

The size of the Great Pacific Ga

Changes to the environment

Scientific innovations can help mitigate environmental damage. For example, **bioremediation** uses microorganisms to clean up oil spills and other **pollutants**, demonstrating how science can address environmental issues.

Bioremediation – the
microbes, to remove p

Pollutants – substan
causing harm to ecos

Mini-case study

The Deepwater Horizon oil spill in 2010 released millions of barrels of oil into the
employed various methods, including bioremediation, to clean up the spill, show
addressing environmental disasters.

The Deepwater Horizon oil spill from the air.

Mini-task

- How does renewable energy technology benefit the environment?
- What are some environmental consequences of industrial activities?

Skill-based question

9 Find and evaluate three reliable sources that discuss strategies for reduci
their environmental implications.

Tips: **Step 1:** Search for articles, reports or websites on reducing plastic
such as government agencies or NGOs.
Step 2: Complete the table below to evaluate the reliability and key poi

Source name	Type (e.g. report, website)	Publisher	Evidence of (e.g. citations, pe

Step 3: Based on your evaluation, explain which source is most reliable,
Summarise the strategies discussed in that source, such as bans on single-
biodegradable alternatives.

Learning aim B: Examine t
different organisations h
contemporary scien

B1 Governmental and global organisatio

Key points covered

- United Nations (UN)
- World Health Organization (WHO)
- International Group of 7 (G7)
- UK government
- Department of He
- National Health Se
- Regulators

Governmental and global organisations play vital roles in shaping policies, addressi
regulating industries. They influence areas such as healthcare, environmental cons
Below, we'll explore these organisations, their responsibilities, and their impact on

United Nations (UN)

The **United Nations (UN)** is an international organisation founded in 1945 to pro
cooperation among nations. It has 193 member states and works across multiple a
human rights, and sustainable development.

Key initiatives:

- The **Sustainable Development Goals (SDGs)**: A set of 17 global goals aimed at ending poverty, improving health, and combating climate change.
- **Climate Action Summit**: The UN brings world leaders together to address climate issues and drive international agreements like the **Paris Agreement**.

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Mini-case study

The UN's role during the COVID-19 pandemic was critical in coordinating interna
organisations like the WHO to ensure equitable access to vaccines through initiat

Handover of COVID-19 vaccines from the COVAX campaign

Mini-task

Research one of the UN's Sustainable Development Goals. Explain how science co achieving this goal.

Skill-based question

10 Summarise the main objectives of the United Nations' Sustainable Develo their relevance to scientific progress.

Tips: **Step 1:** Research the UN's SDGs. Focus on three goals related to good health, and quality education).
Step 2: Use the table below to organise key details:

Sustainable Development Goal	Objective
Climate Action	
Good Health and Well-being	
Quality Education	

Step 3: Write a paragraph summarising how the UN's SDGs contribute using the information in the table.

World Health Organization (WHO)

The **World Health Organization (WHO)** is a specialised agency of the UN that focuses on international **public health**. It provides leadership on health matters, sets global health standards, and coordinates responses to health emergencies.

Key initiatives:

- **Eradicating diseases**: WHO played a key role in eradicating smallpox and continues efforts to eliminate diseases such as polio and malaria.
- **Global vaccination campaigns**: Ensuring widespread access to vaccines to protect against infectious diseases.

Mini-case study

During the COVID-19 pandemic, WHO provided guidance on safety measures, developed vaccination strategies, and monitored the spread of the virus globally.

Mini-task

Investigate how the WHO has contributed to tackling a specific global health cha Possible challenges include but aren't limited to malaria, measles and HIV.

Skill-based question

11 Create a properly formatted Harvard-style reference list for the followin
1. An article discussing WHO's role in eradicating smallpox.
2. A WHO report on global vaccination strategies.
3. A book chapter on public health leadership by WHO.

Tips: **Step 1:** Find the required details for each source, such as author names,
Step 2: Copy and complete the table below to organise reference detail

Source type	Author(s)	Title	Publisher/Journal	Year
Article				
Report				
Book chapter				

Step 3: Write each reference using Harvard formatting. For example:
Smith, J., 2020. WHO's Vaccination Strategies. *Public Health Reports*. 25

International Group of 7 (G7)

The **G7** is an intergovernmental organisation consisting of seven of the world's larg advanced economies: Canada, France, Germany, Italy, Japan, the UK, and the Unite States. It discusses and addresses global economic and political challenges.

Key focus areas:

- Climate change, trade, and economic stability.
- Supporting global health initiatives such as vaccine development and distribut

Mini-case study

The G7 influences global scientific research and healthcare by funding large-scale international collaboration, and shaping global policy. At the 2021 G7 Summit in provide one billion COVID-19 vaccine doses to low-income countries, highlightin **health equity**. This pledge not only addressed immediate public health needs bu international cooperation in vaccine development and distribution. Additionally, t research partnerships, such as those supporting pandemic preparedness, antimic related health challenges. By aligning their economic power with scientific priorit accelerate innovation, fund health-focused research institutions, and ensure that treatments are shared more equitably across the globe.

A photograph of the G7 leaders at the 2021 summit in Cornwa

Mini-task

Explain how the G7 influences global scientific research and healthcare.

Skill-based question

12 The graph below compares the percentage of people in G7 countries wh
a serious threat to humanity in 2023, against the global average. Analyse
trends and differences between the G7 nations and the rest of the world

Tips: **Step 1:** Study the graph carefully, focusing on:

- The percentage of people who believe climate change is a serious t
- The global average for comparison.
- Variations between countries in the G7.

**Share of people who believe in climate change and think it's a serio
threat to humanity, 2023**

Participants were asked to score beliefs on a scale from 0 to 100 on four questions: whether action w
global catastrophe; humans were causing climate change; it was a serious threat to humanity; and wa

Data source: Vlasceanu et al. (2024). Addressing climate change with behavioral science: A global intervention
countries.
Note: Based on survey data across almost 60,000 participants from 63 countries.
OurWorldinData.org/climate-change | CC BY

Step 2: Copy and complete the table below to organise your observatio

Country	Percentage believing climate change is a serious threat	Comp
United States		
Canada		
Germany		
France		
United Kingdom		
Japan		
Italy		
World		

Step 3: Use the following prompts to guide your analysis:

- Which G7 countries have the highest and lowest percentages?
- How do G7 countries compare to the global average?
- Are there any notable differences between individual G7 countries?

Step 4: Write a paragraph summarising the graph, including:

- The overall belief in climate change as a serious threat within G7 c
- How G7 nations compare to the global average.
- Any trends or outliers within the G7.

UK government

The UK government plays a central role in funding scientific research, regulating in challenges through various departments and agencies.

Department of Health and Social Care (DHSC)

The **DHSC** oversees the National Health Service (NHS) and sets policies to improve public health in the UK (**public health policy**). It allocates funding for healthcare services and manages health crises, such as pandemics.

Skill-based question

13 Evaluate the benefits and drawbacks of the DHSC's COVID-19 vaccinati

Tips: **Step 1:** Research the DHSC's vaccination rollout, including successes challenges (e.g. logistical issues).
Step 2: Use the table below to compare benefits and drawbacks:

Aspect	Benefit	
Public health		
Economic		
Logistics		

Step 3: Write an evaluation paragraph, weighing the benefits and drawb effectiveness of the strategy.

National Health Service (NHS)

The **NHS** provides free healthcare to UK residents and invests in medical research a

Mini-case study

The NHS's COVID-19 vaccination programme, launched in December 2020, becar successful in the world, demonstrating effective policy and healthcare delivery.

A post box decorated to thank the NHS during the pandemic

Mini-task

Research a recent medical innovation funded or implemented by the NHS.
Examples: AI-powered skin cancer diagnosis, CRISPR-based gene therapy for sick drones for medical sample transport.

Skill-based question

14 Describe how the NHS implemented its COVID-19 testing and tracing sy
examples of the steps involved.

Tips: **Step 1:** Break the process into key steps (e.g. setting up testing centres,
COVID-19 app).
Step 2: Use the table below to document each step:

Step in the process	Description	
Setting up test centres		
Developing the app		

Step 3: Write a paragraph describing the system, focusing on how it was

Environmental departments

Department for Environment, Food and Rural Affairs (Defra)

Defra handles policies on environmental protection, food production, and animal w
farming practices and climate change mitigation.

Centre for Environment, Fisheries and Aquaculture Science

Cefas conducts research on marine and freshwater ecosystems to support sustaina
environmental protection.

Forestry Commission

The **Forestry Commission** manages forests and promotes sustainable forestry prac
and climate change.

Mini-case study

Defra and the Forestry Commission collaborated in 2021 to plant 7,000 hectares o
England Tree Strategy, enhancing biodiversity and carbon sequestration.

Defra sign on the gate at the entrance to a willow growing area.

Mini-task

Discuss how Defra's work supports environmental sustainability.

Skill-based question

15 Explain the causes and effects of the UK government's decision to ban si

Tips: **Step 1:** Identify key causes of the ban (e.g. environmental concerns, publ
Step 2: Discuss the effects on businesses, consumers and the environme
Step 3: Use a table like the one below to organise your findings:

Cause	Effect	
Environmental concerns		
Public pressure		

Step 4: Write a short paragraph explaining the causes and effects, using
UK policies.

UK Research and Innovation (UKRI)

UKRI funds scientific **research and innovation** across a range of disciplines, from medical advancements to renewable energy technologies.

Research
conducting
ideas to s

Mini-case study

UKRI invested £800 million in 2021 to support the development of green technol
power and carbon capture.

Econom
and Soc
Researc

Mini-task

Identify a UKRI-funded research project and explain its potential impact on societ

Regulators

Environment Agency

The **Environment Agency** ensures compliance with environmental laws, monitors po

Food Standards Agency (FSA)

The **FSA** regulates food safety and quality, ensuring that the food supply is safe an

Medicines and Healthcare products Regulatory Agency (MH

The **MHRA** ensures the safety, quality and effectiveness of medicines and medical

Human Fertilisation and Embryology Authority (HFEA)

The **HFEA** regulates fertility treatments and embryo research, ensuring ethical prac

Mini-case study

The MHRA's rapid approval of COVID-19 vaccines in 2020 allowed the UK to bec
vaccinations, showcasing the importance of regulatory agencies.

Mini-task

Research how the Food Standards Agency (FSA) has contributed to a recent scie
food safety or innovation. Explain the FSA's role in this development and its impa
food industry.

Skill-based question

16 Find and evaluate three reliable sources about the role of the Medicines
products Regulatory Agency (MHRA) in vaccine approvals.

Tips: **Step 1:** Search for reports, articles, or government documents on the M
Step 2: Use the table below to evaluate and summarise the sources:

Source name	Type (e.g. report, article)	Publisher	Evid reli

Step 3: Write a short explanation of which source is most reliable, and
findings about the MHRA's role.

B2 Non-governmental organisations (N

Key points covered

- Professional organisations and learned societies
- Pressure groups, t

Non-governmental organisations (NGOs) are independent organisations that opera governments. They play a crucial role in advancing science, health, education, and NGOs can be classified into professional organisations, learned societies, pressure think tanks. This section explores these categories and their impact on society.

Professional organisations and learned societies

These organisations promote scientific knowledge, research, and professional deve They support their members, provide resources, and influence policy.

Scientific societies

Royal Society of Biology (RSB)

The **RSB** promotes the study of biology through education, **public engagement**, and policy advocacy. It supports research and provides **accreditation** for biology-related degrees. The RSB launched the 'Biology Week' initiative to engage schools and the public in science.

Royal Society of Chemistry (RSC)

The **RSC** advances chemical sciences by funding research, publishing journals, and The RSC's 'Global Experiment' allows students worldwide to participate in collabora

Institute of Physics (IOP)

The **IOP** focuses on advancing physics through education, research, and policy adv resources and supports early-career physicists. The IOP's 'Limit Less' campaign ai groups to pursue physics careers.

The Royal Society

The Royal Society is the UK's national academy of sciences, promoting excellence i humanity. It funds research, publishes journals, and advises policymakers.

Mini-case study

The Royal Society has played a key role in shaping scientific understanding of climate change by publishing influential reports on carbon capture technologies, greenhouse gas emissions, and climate modelling. Its evidence-based recommendations have supported government policies aimed at reducing the UK's carbon footprint and transitioning to low-carbon energy solutions. By bringing together leading scientists and policy experts, the Royal Society continues to guide national and international responses to one of the most pressing environmental challenges of our time.

Physicists in front of the building of Th

Mini-task

Research one programme run by the Royal Society. How does it support scientifi

Medical Royal Colleges

These colleges ensure high standards of training and practice in medicine. They provide resources, conduct examinations, and support healthcare professionals. For example, the Royal College of Physicians develops **guidelines** to improve patient care in hospitals.

Universities and publicly funded research organisations

Universities and research organisations conduct groundbreaking studies in science critical role in knowledge generation and innovation. The UK's Wellcome Sanger I advancing genomic research, including the sequencing of the human genome as p Genome Project. This pioneering work laid the foundation for modern genetic me identify genes linked to inherited conditions and develop targeted treatments. The research in areas such as cancer genomics, rare diseases, and antimicrobial resistan of personalised medicine and public health.

Mini-task

Identify one research project conducted by a UK university. Explain its societal im

Skill-based question

17 Summarise the key roles and contributions of two professional organisati advancing scientific knowledge and public engagement.

Tips: **Step 1:** Choose two professional organisations or learned societies to re
Step 2: Research their main activities and contributions, such as public e research, or educational outreach.
Step 3: Complete the table below to organise your findings:

Organisation	Main activities	Examples of contributio

Step 3: Write a short summary (100–150 words) comparing the two or advancing scientific knowledge and engaging the public.

Pressure groups, trusts, and charities

These **NGOs** focus on **advocacy**, raising awareness, and funding initiatives in various areas such as health and the environment.

NGOs (indepe locally environ

Advoc decisio system

Environment and conservation

Greenpeace

An environmental group campaigning against climate change, deforestation, and ocean pollution. Greenpeace pressured corporations like Coca-Cola to reduce plastic waste.

Friends of the Earth

Advocates for **sustainable development** and renewable energy. Friends of the Earth successfully lobbied for the UK Climate Change Act 2008.

National Trust

Preserves natural and historic sites in the UK. The National Trust manages over 250,0 protect biodiversity. It also plays a key role in caring for land within and around nati walking routes, conserve habitats, and promote sustainable tourism. By working in p and environmental organisations, the Trust supports the long-term protection of the

National Farmers' Union (NFU)

Represents farmers and growers in England and Wales, promoting sustainable agri production and rural communities.

Health charities

The King's Fund	Action on Smoking and Health (ASH)	British Heart Foundation (BHF)	Cancer Research UK	Terenc Tr
A health think tank improving healthcare in England. The King's Fund publishes reports on NHS performance and patient care.	Focuses on reducing tobacco-related harm. ASH's campaigns led to the UK's ban on smoking in public places.	Funds cardiovascular research and raises awareness of heart health. BHF developed an online risk calculator for heart disease prevention.	Supports cancer research and patient education. Cancer Research UK's Race for Life raises millions annually for cancer research.	A UK-ba charity t support living wi and wor promote health th educatic advocac confider services.

Mini-task

Choose a health charity. Research one of its recent campaigns and explain its out

Think tanks

Think tanks are NGOs that conduct research and provide **policy recommendations**. They often influence governmental decisions.

Poli prov proc

Institute of Economic Affairs (IEA)	Chatham House
The **IEA** promotes free-market economics through research and publications.	A global policy institute addressing international affairs and global challenges. Chatham House's research on food security guides international policies. It also produces in-depth analysis on climate change, public health, and technology, helping governments and organisations make evidence-based decisions.

Skill-based question

18 Create a Harvard-style reference list for the following sources about env groups and their campaigns:

1. A report on Greenpeace's campaign against single-use plastics.
2. A book chapter on the National Trust's conservation efforts.
3. An academic article evaluating Friends of the Earth's renewable ene

Tips: **Step 1:** Research or imagine the details required for each source, such as and title.

Step 2: Copy and complete the table below to organise the reference in

Source type	Author(s)	Title	Publisher/Journal	Year
Report				
Book chapter				
Academic article				

Step 3: Use Harvard referencing format to create the citations.

- **Example:** Smith, J., 2021. Greenpeace's Campaign Against Single-U *Reports*, 12(3), pp. 45–60.

Step 4: Reflect on why proper referencing is essential for academic integ

B3 Businesses including multinationals

Key points covered

- Utilities: energy companies, water companies
- Pharmaceutical companies
- Health food companies
- Tobacco companie
- Food producers, a

Businesses play a crucial role in the economy and society by providing essential go corporations (MNCs) operate across multiple countries, contributing to economic g innovation. However, their activities can have social, ethical and environmental im key industries, including utilities, pharmaceuticals, health food, tobacco, and food p

Utilities: energy and water companies

Utilities are essential services that provide electricity, gas and water to households companies play a vital role in maintaining infrastructure, ensuring public health, an energy sector, utility companies are central to the development and implementatio such as offshore wind farms.

Utility companies are involved in every stage of a wind energy project – from plann construction, grid connection, and maintenance. They assess suitable offshore loca technology, and work with engineers to build the infrastructure needed to generat the UK, projects like Hornsea One and Two, operated by Ørsted, are examples of su wind farms developed with the support of utility companies.

These projects help reduce carbon emissions, diversify energy sources, and increase electricity. By investing in wind energy, utility companies also support national effo targets, while creating jobs and stimulating innovation in the green economy.

Energy companies

Energy companies generate and distribute power using different sources:

- **Fossil fuels (e.g. coal, oil, natural gas)** – widely used but contribute to green
- **Renewable energy (e.g. wind, solar, hydro)** – environmentally friendly alter

Mini-case study

Ørsted, a Danish multinational, transitioned from fossil fuels to renewables and is wind power.

Water companies

Water utility companies manage the supply and treatment of water. They ensure s
wastewater treatment.

- **Thames Water** (UK) supplies water to millions and treats wastewater to reduc
- **Desalination plants** in countries like Saudi Arabia help provide drinking wate

Mini-task

Research and explain how water utility companies such as Thames Water, and de
such as Saudi Arabia, contribute to water management.

Skill-based question

19 Describe the role that utility companies play in implementing wind energ
the UK's offshore wind farms.

Tips: **Step 1: Understand the key terms**

- Utility companies – businesses that provide essential public services
(e.g. SSE, Ørsted, ScottishPower).
- Offshore wind farms – wind turbines located at sea, used to genera
- Implementation – planning, building and managing wind energy proj

Step 2: Identify what utility companies do

Think about their responsibilities, such as:

- Planning and funding offshore wind farms.
- Building and installing turbines and infrastructure.
- Maintaining and operating wind farms.
- Supplying electricity to homes and businesses.
- Meeting government targets for renewable energy.

Step 3: Use a real example

Mention a specific offshore wind project in the UK:

- Example: Hornsea Project by Ørsted – one of the largest offshore
- Mention how utility companies helped bring it to life (e.g. investmen

Step 4: Link to sustainability and energy goals

Explain how utility companies help to:

- Reduce carbon emissions.
- Provide cleaner energy alternatives to fossil fuels.
- Support the UK's net zero targets.

Step 5: Write a clear response

Use this structure:

- Introduction – briefly explain what utility companies and offshore w
- Main body – describe the company's role and give a UK example.
- Conclusion – summarise how these efforts support sustainable ene

Pharmaceutical companies

Pharmaceutical companies develop, produce and distribute medicines and vaccines
health. Their work involves extensive research, testing, and regulatory approval.

Key contributions:

- **Drug discovery** – identifying and developing new treatments.
- **Clinical trials** – testing medicines to ensure safety and effectiveness.
- **Vaccine production** – protecting populations from infectious diseases.

Mini-case study

The development of a malaria vaccine marks a significant breakthrough in global
RTS,S/AS01 (Mosquirix) vaccine, developed by GlaxoSmithKline (GSK), became th
recommended by the World Health Organization (WHO) for widespread use amo
More recently, the R21/Matrix-M vaccine, developed by Oxford University and ma
Institute of India, showed high efficacy in large-scale trials and received WHO ap
are expected to save thousands of lives annually by reducing severe illness and d
falciparum, the deadliest malaria parasite. The rollout of malaria vaccines represe
disease prevention, particularly in sub-Saharan Africa, where malaria remains a le

Poster advertising trials of the RTS,S vaccine.

Skill-based question

20 Find and evaluate three reliable sources about the effectiveness of mRNA

Tips: **Step 1:** Search for academic articles, government reports, and trusted w
Step 2: Complete the table below:

Source name	Type (article, report, study)	Publish

Step 3: Choose the most reliable source and explain why.

Health food companies

Health food companies produce and market food products that promote well-bein
supplements, and functional foods (e.g. probiotic yoghurt, plant-based protein).

Key trends in the industry:

- **Organic and natural foods** – reducing synthetic chemicals in food production
  producing food using natural substances and processes, avoiding synthetic pes
  This method aims to improve soil health, promote biodiversity, and reduce env
  non-organic food production often relies on chemical treatments and genetica
  to increase crop yields and reduce pests, which can leave residues on food and

  While non-organic farming is typically more **cost-efficient** and scalable, orga
  valued for being **environmentally friendly** and for **reducing exposure to sy**
  research continues to compare the **nutritional value, health impacts**, and **su**
  driving innovation in **organic fertilisers**, **biological pest control** and **clean-la**
  consumer demand grows, more companies are investing in organic alternative
  development in sustainable agriculture.

- **Superfoods** – nutrient-rich foods such as chia seeds, quinoa and acai.
- **Meat alternatives** – companies such as Beyond Meat and Impossible Foods d

Mini-case study

UK-based company Quorn produces mycoprotein, a high-protein meat substitute This innovative food product is considered a sustainable alternative to traditional less land, water and energy to produce. Unlike livestock farming, which contribut emissions, mycoprotein production has a lower environmental impact and suppo efforts to combat climate change.

This development relates to several contemporary scientific issues, including food security, sustainable agriculture, and reducing global carbon footprints. As globa demand for protein rises, and environmental concerns grow, alternatives like mycoprotein offer scalable solutions for feeding the population while protecting natural resources. Quorn's success also highlights how biotechnology and food science are driving innovation in the quest for healthier and more environmentall responsible diets.

Mini-case study

The global organic food market has experienced significant growth, driven by inc healthier and environmentally sustainable products. For instance, in the United S is projected to grow from approximately $65.55 billion in 2024 to $159.04 billion compound annual growth rate (CAGR) of 10.35%.

This surge in demand has spurred scientific research and innovation in several ke

- Agricultural practices: Scientists are developing advanced organic farming te health, increase biodiversity, and reduce reliance on synthetic inputs.
- Pest and disease management: Research into natural pest control methods a varieties is expanding to meet organic standards without synthetic chemicals
- Food processing and preservation: Innovations in processing methods aim to quality of organic foods while extending shelf life without artificial preservati

Companies are investing in these scientific developments to improve the efficienc food production. This intersection of market growth and scientific research unde relationship between consumer preferences and technological advancement in th

Mini-task

Summarise the key differences between organic and non-organic farming practic

Skill-based question

21 Explain and evaluate the impact that businesses have on health.

Tips: **Step 1: Understand the question**

- 'Explain' means you should describe how businesses affect health (p
- 'Evaluate' means you should assess the importance, impact or effec benefits and drawbacks, with some justification or conclusion.

Step 2: Identify different types of businesses

Consider a range of industries that influence health, such as:

- Pharmaceutical companies (e.g. developing vaccines or medications)
- Health food companies (e.g. promoting plant-based or organic diets
- Tobacco and alcohol industries (e.g. contributing to public health co
- Fitness and wellness brands (e.g. gyms, supplements)
- Technology companies (e.g. mental health apps, wearable health mo

Step 3: Explain the impacts

Business type	Positive health impact	Nega
Pharmaceutical		
Health food		
Tobacco		
Wellness/Fitness		
Tech (e.g. apps)		

Step 4: Evaluate the overall impact

- Compare the benefits and harms of different industries.
- Consider how businesses are regulated (e.g. by the MHRA or FSA).
- Include long-term consequences (e.g. health inequalities, economic
- Ask: Do the positives outweigh the negatives? Is the impact consist

Step 5: Structure your answer

Use this format:

- Introduction: Briefly state that businesses have both positive and ne
- Main body paragraphs:
  - One paragraph per business type (with examples and explanati
  - Evaluate the impact (how significant, widespread or preventabl
- Conclusion: Summarise your judgement, e.g. 'While some businesse through innovation and awareness, others contribute to long-term stricter regulation.'

Tobacco companies

Tobacco companies produce cigarettes, cigars, and smokeless tobacco products. T regulated due to the health risks associated with smoking.

Impact of tobacco industry:

- **Health effects** – smoking-related diseases include lung cancer, heart disease,
- **Marketing regulations** – advertising bans and warning labels are enforced in
- **Emerging trends** – the rise of e-cigarettes and vaping as alternatives to tradit

Mini-case study

In 2016, the UK enforced plain packaging laws for cigarettes, removing branding among youth.

Skill-based question

22 Create a Harvard-style reference list for the following, and explain why p
- A government report on smoking regulations.
- An academic study on vaping.
- A book on tobacco industry history.

Tips: **Step 1:** Gather publication details.
Step 2: Format them using Harvard referencing style.
Step 3: Explain why proper referencing is important.

Food producers, agriculture, and fisheries

This sector is responsible for feeding populations through farming, livestock and fi
sustainability, and environmental impact are key concerns.

Types of food production:

- **Industrial agriculture** – large-scale farming using technology for mass produ
- **Sustainable farming** – organic and regenerative practices to protect soil heal
- **Aquaculture** – fish farming to meet growing seafood demand.

Mini-case study

Overfishing in the Atlantic Ocean has significantly depleted fish stocks, particular
haddock. This unsustainable harvesting has disrupted marine ecosystems and th
viability of the fishing industry. In response, governments and environmental ag
quotas – limits on the amount or number of specific fish species that can be lega
period, usually per year.

Quotas are designed to help conserve fish populations by ensuring that they are
reproduce. These limits are based on scientific assessments of fish stock health a
national and international agreements, such as those by the Common Fisheries P
guidelines from the International Council for the Exploration of the Sea (ICES).

The introduction of stricter quotas in the Atlantic has helped stabilise some fish p
affected the livelihoods of fishing communities, who must now operate within tig
these measures are vital for promoting sustainable fishing, protecting marine bio
generations can continue to rely on the ocean for food and income.

Mini-task

Research a recent report on global fish stock depletion and summarise the key fi
overfishing, conservation efforts, and future projections.

Learning aim C: Understan evaluate and report scientific

C1 Reporting of scientific information

!	*Key points covered*

- Reporting medium
- The target audienc

Scientific discoveries and advancements must be communicated effectively to diffe is reported influences public perception, policy decisions, and future research. This reporting mediums, the impact of social media, and how scientific information is ta

The challenges in science communication are:

- Complexity: Scientific concepts can be challenging to simplify without oversimplification or inaccuracy.
- **Jargon**: Many people can 'switch off' when they hear technical or scientific terms.
- Misinformation: Countering false information and promoting accurate science
- Public engagement: Motivating the public to engage with science can be chall

Effective science communication strategies can include:

- Knowing your audience: Understand the target audience's knowledge level, in
- Simplify without oversimplifying: Explain complex concepts clearly and accurat metaphors when possible.
- Tell a story: Engage the audience by weaving scientific information into a com
- Use visuals: Graphs, charts and images can enhance understanding.
- Be accessible: Use plain language and avoid jargon.
- Foster dialogue: Encourage questions and feedback.
- Influence on social media: Make use of platforms like X, Instagram, YouTube a wider audience.
- Build relationships: Collaborate with journalists, educators, and community lea

Reporting mediums

Scientific information is communicated through various platforms, ranging from highly technical journals to social media posts. Each medium has a different level of reliability, audience and impact.

Specialist or peer-reviewed journals

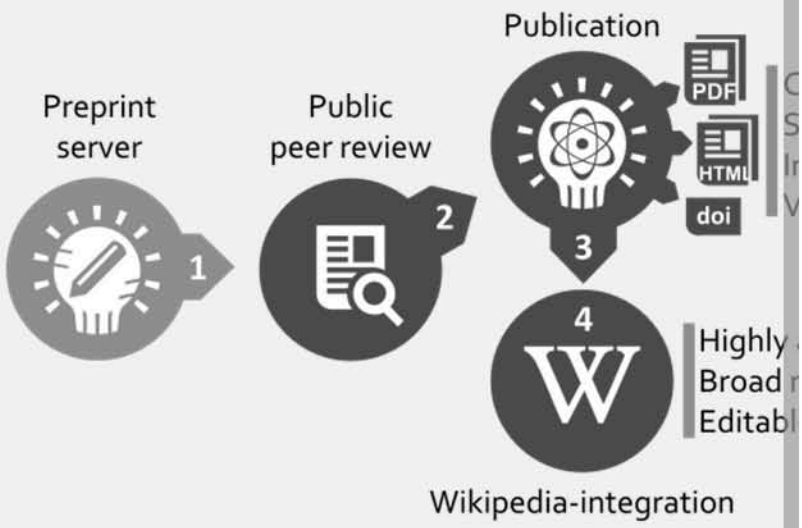
These are high-quality scientific publications reviewed by experts before publication. They ensure **accuracy** and **credibility**, making them essential for the **scientific community**.

Examples:

- ***Nature*** – a leading journal covering all scientific disciplines.
- ***The Lancet*** – a respected medical journal publishing research on global health issues.

Mini-case study

The safety and effectiveness of COVID-19 vaccines were published in peer-review
The New England Journal of Medicine and *The Lancet*, helping governments make
roll-outs.



Steps involved in science publishing.

Mini-task

Pick one of the following peer-reviewed journal articles on climate change and su
key findings:

1) **zzed.uk/12837-Climate-1**
2) **zzed.uk/12837-Climate-2**

Science magazines

Science magazines bridge the gap between technical journals and the public by pre
a more accessible, engaging format. While technical journals are written by and fo
language, complex data and detailed methodologies, science magazines simplify co
audience. They often use clear language, visual aids such as diagrams and infograp
examples or interviews to make content easier to understand.

Science magazines focus on the implications and relevance of scientific findings rat
process itself, whereas journals typically include raw data, peer-reviewed results, an
For example, a journal article on CRISPR may present genetic sequences and experi
science magazine article might explain how CRISPR could lead to cures for genetic
makes science magazines a valuable tool for science communication, education, an
understanding of emerging scientific issues.

Examples:

- ***New Scientist*** – covers cutting-edge science in an engaging format.
- ***Scientific American*** – features in-depth analysis on various scientific topics.

Mini-task

Write a review of a piece of science communication you have watched, read or lis
Include:

- how the scientist has communicated complicated ideas in a simple way
- any use of images, storytelling or other techniques
- who do you think the target audience is
- the advantages and disadvantages of the media for communicating the idea

Newspaper articles (local, national and international)

Newspapers play a role in communicating **breaking scientific news** and influencing public opinion. However, they may **oversimplify** or **sensationalise** science to attract readers.

Examples:

- ***The Guardian* (UK)** – known for detailed climate change reporting.
- ***The New York Times* (USA)** – features a dedicated science section.

Mini-task

Find a recent newspaper article about a scientific discovery and assess its reliabil
Use the checklist to help with your assessment.

Criteria	Yes/No	Notes
Reputable newspaper		
Mentions original research		
Author has credentials		
Accurate use of terminology		
Balanced and neutral tone		
Includes expert quotes		

TV news, documentaries, film, and television series

Television and documentaries can visually demonstrate scientific concepts, making them more **engaging** and **accessible**. However, they may also introduce **bias** or **misinterpretations** for dramatic effect.

Examples:

- ***David Attenborough's Blue Planet II*** – highlighted the impact of plastic pollution.
- ***The Martian* (2015)** – based on real NASA science but dramatised for entertainment.

Mini-task

Watch a science documentary and write a short review on its accuracy.
Use the checklist to help with your review.

Criteria	Yes/No	
Is the science explained clearly and correctly?		
Are facts supported by real scientific evidence or data?		
Are any scientists or credible experts interviewed?		
Are complex ideas simplified without being misleading?		
Is the information up to date?		
Are there any signs of bias or exaggeration?		
Are visuals (diagrams, animations, models) used accurately?		
Does it reference real-world applications or implications?		

Internet and social media

The **Internet** has transformed how science is reported, but it also raises concerns about **misinformation**.

Impact of social media on science reporting

- **Advantages:** Instant access, global reach, interactive discussions.
- **Disadvantages:** Misinformation spreads quickly, difficulty verifying sources.

Mini-case study

In recent years, the re-emergence of measles in parts of the United States has be
of online misinformation about vaccines. Once considered eliminated in the US i
several outbreaks – particularly in communities with low vaccination rates.

A key driver of this trend is the rise of anti-vaccination misinformation on social n
claims about vaccine safety, such as links to autism or harmful side effects, have g
Despite being scientifically disproven, these claims have led some parents to dela
immunisations.

This misinformation undermines public trust in science and reduces herd immuni
like babies, elderly people, and those with weakened immune systems – at greate
scientific misinformation, when unchecked, can have serious consequences for pu
the importance of accurate science communication and responsible media report

Popular social media applications.

Mini-task

Find a viral science-related social media post and evaluate its accuracy.

Skill-based question

23 Find and evaluate three reliable sources that report on the effects of mic
Compare how the issue is presented for different audiences (e.g. the pub
people). In your answer, comment on the language used, the level of sci
style of each source.

Tips: **Step 1: Choose three reliable sources**
Pick one from each category to compare how different types of audience

- Scientific journal or research report (e.g. *Nature*, *Science*, academic
- News article or mainstream magazine (e.g. BBC News, *National Ge*
- Youth-focused/interactive format (e.g. YouTube explainer, infograp
  Nat Geo Kids)

Step 2: Complete the table below to organise your observations:

Source	Audience	Type of source	Language/ Tone	Scientific detail

Step 3: Analyse the differences
Think about:

- Who is the content designed for? (e.g. scientists, everyday readers
- Is it simplified or in-depth?
- Are visuals used to help explain the topic?
- Is it persuasive, neutral, or informative?

Step 4: Write a short evaluation (a paragraph or two)
Use sentence starters:

- 'The scientific journal is aimed at… and includes technical terms lik
- 'In contrast, the news article simplifies this by saying…'
- 'The youth-focused source uses visuals such as… to engage a youn
- 'This shows how the same issue is presented differently depending

Step 5: Conclusion
Wrap up by answering:

- Which audience is most likely to **understand the issue clearly**?
- Which source is **most reliable or informative**, and why?
- How does the way information is presented affect **how people u**
  to science?

The target audience

Scientific reporting is tailored to different audiences based on age, education level, **interests** and **social influence**.

Intere
the ty
engag

Socia
societ
percei

General public

The public needs science to be clear, engaging, and relevant to daily life.

Example: Articles on health and wellness in mainstream magazines.

Social groups (generations, activities, and pastimes)

Different age groups consume science differently:

- **Older adults** (people over 60) may prefer traditional news sources such as TV
- **Younger generations**, such as millennials and Gen Z, often engage with scien digital content.

Example: Science influencers on TikTok making climate change content for younger audiences.

Peer-r
publica
before

Confer
presen

Techni
that ex
experi

Scientific community

Scientists use **peer-reviewed journals**, **conferences** and **technical reports** to share research.

Example: Scientists publishing in *Nature* to share discoveries with peers.

Pressure groups and lobbyists

These groups use scientific reports to influence public policy and corporate decisio

Some ways which pressure groups use science include:

- Providing evidence: Science can provide compelling evidence to support press example, environmental groups might use scientific data to demonstrate the h climate change.
- Shaping policy agendas: Scientific research can help pressure, voluntary and ch policy agendas. By understanding the latest scientific findings, groups can adv on evidence and are likely to be effective.
- Mobilising support: Science can be used to gather public support for these gro scientific consensus on a particular issue, groups can build a broader base of s
- Holding governments accountable: Science can be used to hold governments Pressure and charitable groups can use scientific evidence to expose governm more stringent regulations.
- Framing issues: Science can help pressure groups frame issues in ways that res presenting complex scientific information in a clear and understandable way, g more persuasive.
- Shared goals: Science can foster collaboration between voluntary and charitab stakeholders, such as government agencies, academic institutions, and busines findings and working together on common goals, these organisations can ach

Example: Greenpeace using climate science to push for stricter environmental laws

Political representatives

Governments use scientific reports to make decisions on public health, energy policie

The role of science in policymaking includes:

- Evidence-based policy: Scientific research provides the foundation for develop and efficient.
- Risk assessment: Scientists help evaluate potential risks and benefits of differe
- Monitoring and evaluation: Scientific data are used to assess the impact of po necessary adjustments.
- Public understanding: Scientists can communicate complex issues to the publi public discourse.

Mini-case study

The UK government's Scientific Advisory Group for Emergencies (SAGE) provides to help manage national emergencies. In 2018, during an intense heatwave that wildfires, and infrastructure strain, SAGE was convened to assess the impact of ex health and services. The group advised on emergency planning, including guidar homes, water resource management, and hospital preparedness for heat-related recommendations informed the government's Heatwave Plan for England, aimed preventing deaths during future extreme weather events.

Skill-based question

24 Create a properly formatted Harvard-style reference list for the followin

- A government report on climate change.
- A peer-reviewed journal article about vaccine development.
- A science magazine article on space exploration.

Tips: **Step 1:** Research or generate relevant citation details.
Step 2: Complete the table below:

Source type	Author(s)	Title	Publisher	Year	Additional d

Step 3: Format the references in Harvard style, e.g.:

- Author, A., Year. *Title of the Source*. Publisher. Available at: [URL]

C2 Scientific information

Key points covered

- Different types of scientific information
- Validity and reliabi

Scientific information is the foundation of research, innovation, and technological a how data is collected, analysed and validated is essential for evaluating its accuracy explores different types of scientific information, the factors that determine its valic misinformation can distort scientific understanding.

Non-nume represente

Characteri of somethin

Observatic what is see

Interpretat assigned to

Different types of scientific information

Scientific information can be broadly classified into qualitative and quantitative data.

Qualitative data

Qualitative data refers to **non-numerical** information that describes **characteristics**, **observations** and **interpretations**. It is often collected through interviews, case studies, and descriptive reports.

Examples of qualitative data:

- **Medical research**: Patient feedback on the effectiveness of a new treatment.
- **Environmental studies**: Observations of animal behaviour in a conservation a
- **Social sciences**: Interview-based studies on people's attitudes towards climate

Key characteristics:

- Collected through observations, **interviews** or **descriptive studies**.
- Often used in **exploratory research** to generate hypotheses.
- Provides **detailed context** but may lack numerical precision.

Mini-case study

Scientists use qualitative research to understand how different communities perceive climate change. Interviews and surveys help identify regional differences in climate awareness and adaptation strategies.

Quantitative data

Quantitative data refers to **numerical** information that can be measured, analysed statistically, and represented in graphs or tables. It provides **objective and precise** results.

Numerica than word

Objectiv facts, free

Statistics – the collection, analysis and interpretation of numerical data.

Mathematical models – equations or formulas used to represent real-world situations.

Comparisons – identifying similarities and differences between data sets.

Trends – patterns or general directions observed in data over time.

Predictions – forecasts about future events based on data analysis.

Examples of quantitative data:

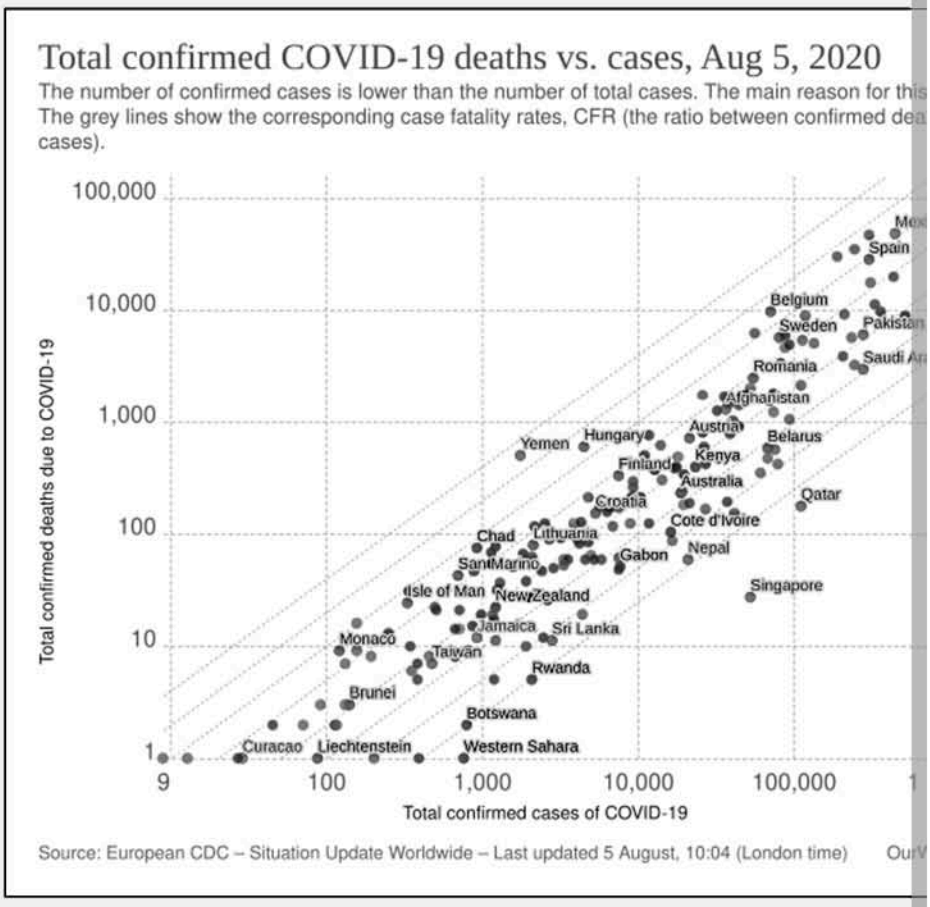
- **Medical trials**: Percentage of patien vaccine.
- **Chemistry experiments**: Measurem a chemical reaction.
- **Public health reports**: Graphs show across different regions.

Key characteristics:

- Based on numbers, **statistics** and **m**
- Allows for **comparisons**, **trends** and
- Often presented in graphs, charts a

Mini-case study

During the COVID-19 pandemic, governments tracked infection rates using quan Daily case counts and hospitalisations were presented in charts to inform policy d



Mini-task

Find a quantitative data set (e.g. a population growth chart) and describe its tren

Skill-based question

25 Find and evaluate three sources that present both **qualitative** and **qua** topic of your choice.

Tips: **Step 1:** Choose a topic (e.g. climate change, medicine, space exploration
Step 2: Find sources that include qualitative and quantitative data.
Step 3: Complete the table below:

Source	Type (qualitative or quantitative?)	Key findings	Reli (Peer-reviewe

Step 4: Choose the most reliable source and explain why.

Validity and reliability of source information

The credibility of scientific information depends on factors such as sample size, bia digital security.

Sample size

Sample size refers to the number of **subjects**, participants or **data points** included in a scientific study or experiment. A larger sample size improves the validity and reliability of the results in several ways.

Firstly, it helps to ensure that the findings are more representative of the wider po of anomalies or outliers. For example, a health study with 1,000 participants is mor trends than one with only 10, as it captures a broader range of characteristics such genetic differences.

Secondly, a larger sample size reduces the effect of random variation and increases detect a true effect or relationship if one exists. This means researchers can be mo not due to chance.

Lastly, studies with larger sample sizes are more likely to produce repeatable and c conducted again, which is a key aspect of scientific reliability. In contrast, studies w greater risk of producing misleading or non-generalisable conclusions.

Example: A drug trial with 100 participants is less reliable than one with 10,000 par

Mini-task

Explain why a large sample size improves scientific reliability.

Selection bias

Selection bias occurs when certain groups are **over-represented** or **under-represented** in a study, leading to skewed results.

Example: If a study on heart disease only includes young adults, it may not apply to older populations.

Mini-case study

Psychological research has long been criticised for relying heavily on participants Western, Educated, Industrialised, Rich and Democratic. These groups represent portion of the global population, yet much of what we know about human behav involving WEIRD samples, particularly university students in the US and Europe.

For example, research on decision-making, morality or perception conducted in W reflect how people from non-Western cultures think or behave. This raises questi generalisability of psychological findings. In one well-known study, researchers fo non-Western communities perceived visual illusions differently, highlighting how shape cognition in ways WEIRD-focused studies may overlook.

This issue has prompted a growing movement within psychology to include more samples in research. Doing so not only improves the reliability and fairness of psy helps develop more inclusive theories that better represent the global populatio

References and authenticity/peer-review

Peer-review is the **evaluation** of scientific work by experts before publication. It ensures research is **credible**, accurate and unbiased.

Example: Studies published in *Nature* or *The Lancet* are peer-reviewed, meaning they have been critically assessed by scientists in the field.

Evaluation – the process of assessing data, research or fi for quality and reliability.

Credible – reliable and trustw based on evidence and exper

The peer-review process

Many processes in scientific research are subject to **peer**-review. These include publication of journal articles, acceptance of lectures and presentations at conferences, and the awarding of grants to fund research.

We will look at the peer-review process as it applies to the publication of a journal article, but the process is similar for other reviews.

peer – level. F the sa scienc or clos and wit

Let's say a research group consisting of two postgraduate students, one postdoct group supervisor (university lecturer or similar) has reached a stage in their work be published. One member of the group will write the article, often referred to a get input from other members of the group.

The article will then be sent to a suitable journal where the editor will receive it. T whether or not the article is suitable for that journal. If it is, then the editor will se reviewers. These reviewers will be peers of the group supervisor. Often, the nam institution where it came from are removed, so the review is done 'blind'. In man names and institution are left in place so that the reviewers can see where the art

The reviewers will then each, independently, write a report on the article. The re
- recommendation to publish, publish with amendments, or not publish
- suggestions for other points to include
- suggestions for further experiments that need to be done and included

The reviewers then send their reports back to the editor.
Sometimes, the two reviews can be contradictory.
If this is the case, then the final decision rests with the editor.

Next, the editor sends the reports back to the author with an explanation of what has been. In most cases, the names of the reviewers are withheld, so the authors cannot see who reviewed it.

Advantages of the peer-review process in this case include ensuring that the a and as accurate as possible before it can be published.

Disadvantages include the duration of the process, which can mean months el the article and its final publication. This can be so long that either a competit another – less rigorous – journal first, or the results are no longer as relevant. include bias if the author names are known to the reviewers. In addition, work far is now known in the community of researchers before publication.

Mini-task

Do you think the peer-review process for publication of journal articles should be
- blind – in that the reviewers can see the names of the authors, but the autho the reviewers?
- double-blind – in that the reviewers cannot see the names of the authors, an names of the reviewers?
- transparent – in that the reviewers can see the names of the authors, and the of the reviewers?

Explain your reasoning, bearing in mind that people in research communities, eve know each other personally or know of one another from reputation and previou

Use and misuse of data

Data can be manipulated or misinterpreted, leading to misleading conclusions.

Examples of data misuse:
- **Cherry-picking data** – selecting only results that support a specific viewpoint
- **Misleading graphs** – using different scales to exaggerate trends.
- *e.g. A company claims that their product 'kills 99% of germs', but the study teste result unreliable.*

Mini-task

Give a pro and a con of public open-source research data. You can use this artic
zzed.uk/12837-Open-Source

Misinformation and disinformation

- **Misinformation** – false or misleading information shared without intent to de
- **Disinformation** – deliberately false information spread to manipulate public p

Misinformation and disinformation can spread for several different reasons in diffe
Some examples are below:

- Social media: Platforms such as Facebook, X and TikTok allow false informatio
- Traditional media: While more regulated, traditional media can also contribute reporting, lack of scientific understanding or lack of fact-checking.
- Politics: Politicians and political groups may intentionally spread misinformatic
- Anti-science groups: Organisations with vested interests in undermining scien spread disinformation.

Impact of misinformation/disinformation can include:

- Erosion of trust: Misinformation can erode public trust in scientists and scienti
- Public health crises: The spread of misinformation about vaccines or infectious consequences.
- Environmental damage: Misinformation and disinformation about climate cha this global crisis.

Strategies to improve trust will involve tackling misinformation and disinformation different strategies:

- Improving **scientific literacy**: It goes beyond simply knowing scientific facts; it involves understanding the scientific process, being able to evaluate scientific evidence, and applying scientific knowledge to real-world problems.
- Supporting fact-checking organisations and initiatives.
- Encouraging social media platforms to take more responsibility for the conten shared on their platforms.
- Improving the way scientists communicate their findings to the public.
- Considering appropriate regulations to protect the public from harmful misinf

Example: During the COVID-19 pandemic, false claims about vaccine side effects s to hesitancy.

Mini-task

Identify a recent case of misinformation and explain its impact on public understa

Digital security

Data can be manipulated or misinterpreted, leading to misleading conclusions.

Digital security ensures that scientific data is protected from **cyberthreats, hacking** and **manipulation**.

Example:

- Researchers use encrypted databases to store patient records securely.

Cyberthreats access, dama

Hacking – ga computer syst disrupt data.

Manipulation distortion of da

Mini-case study

In 2009, a major controversy known as Climategate erupted when hackers illegal
1,000 emails and documents from the Climatic Research Unit (CRU) at the Univer
emails, exchanged between climate scientists, were taken out of context by clima
manipulation of climate data. This incident occurred just before the UN Climate
Copenhagen, casting doubt on the credibility of climate science and fuelling pub

Although multiple independent investigations later cleared the scientists of wro
confidence and the scientific community's reputation was significant. Climategat
importance of digital security in scientific research – showing how cyberattacks c
discredit legitimate science.

The case raised awareness about the need for research institutions to protect se
transparently, and maintain cybersecurity protocols, especially in politically sensit
It also reinforced how easily scientific information can be misused when taken ou
without proper explanation.

University of East Anglia.

Mini-task

Explain why digital security is essential for scientific research.

C3 Presenting scientific information

Key points covered

- Level of scientific detail
- Style of writing and reporting: past tense, passive voice and in third person
- Importance of independent or biased information
- Differentiating between quantity and quality of scientific information
- Use of visual and graphics for interpretation
- Level of referencin
- Correct and consis Vancouver referen
- Evidence to suppo
- Critically valuating conclusions prese
- Considering why it understand scienc

Presenting scientific information effectively is crucial for clear communication, cred making. This section explores how to use scientific terminology, appropriate writin tools to present information accurately and effectively. It also highlights the impor public understanding of science.

Level of scientific detail

Scientific information must be presented with the correct scientific terminology, la clarity and precision.

Key aspects:

- Scientific terminology – using the correct technical terms enhances accuracy and prevents misunderstandings.
- Language – should be precise, **formal** and objective. Avoid ambiguous terms.
- Accuracy – scientific information must be fact-checked, sourced, and free from errors.

Example: The term 'global warming' was replaced with 'climate change' in scientifi describes the complex effects of temperature changes beyond just warming.

Mini-task

Identify five technical terms used in genetics and explain their meanings. Refer b earlier in the guide to help you.

Skill-based question

26 Identify five scientific terms related to climate change and explain their m

Term	Defi

Style of writing and reporting

Scientific writing follows specific conventions to maintain objectivity and professio

Key writing styles:

- Past tense – used when reporting completed research (e.g. 'The experiment *w*
- Passive voice – keeps the focus on the research, not the researcher (e.g. 'The t
- Third person – avoids personal pronouns to maintain formality (e.g. 'It *was obs*

Mini-task

Rewrite the following sentence in past tense, passive voice, and third person:
'I measured the temperature and found that it increased by 2°C.'

Importance of independent or biased information

Scientific reporting must be objective and free from bias. However, bias can appear in research through **funding sources**, selective data reporting, or personal beliefs.

Key differences:

- Independent research – conducted without external influence, ensuring reliability.
- Biased research – influenced by funding, politics, or industry interests, leading to misleading conclusions.

Mini-case study

Tobacco companies funded studies to downplay the health risks of smoking, leading to decades of misinformation.

Look at the images and text used in the advertisement. What elements show misinformation.

Advert promoting Chesterfield cigarettes in 1951.

Mini-task

Find out about the EXCEL heart stent trial and explain how potential bias in the re understanding and trust in medical treatment.

In your answer, consider the role of data interpretation, conflicts of interest, and h reported to doctors and the public.

Differentiating between quantity and quality of scientific in

More information does not always mean better information. High-quality scientific well-sourced, and based on reliable data.

Key indicators of quality:

- Reputable sources – published in scientific journals or government reports.
- Data transparency – clearly explains methods and results.
- Replicability – findings should be **repeatable** by other scientists.

Mini-task

Compare two texts on the same topic – one from a scientific journal or science m social media. Identify differences in quality.

Use of visual and graphics for interpretation

Data should be visually represented to improve understanding.

Common visuals in science:

- Graphs – show trends and comparisons.
- Diagrams – explain complex concepts (e.g. cell structures).
- Tables – organise large amounts of data.

Mini-task

Find an example of a scientific graph and interpret what it shows.

Level of referencing, and sources of information

When you make a statement that draws on existing knowledge on your subject, yo quoting the source of the information.

By referencing your statement, you add authority to it, and you also show that you author, hence showing that you are not claiming to have discovered yourself the fa

Scientific reports must **cite** sources correctly to give credit and allow verification.

There are two main ways of referencing: in-text and end-text.

In-text referencing puts the author(s) and the date after or with the statement whic For example, an in-text reference may look like this:

'It has been previously shown that X causes Y (Smith and Jones, 2024).'

or

'It has been previously shown by Smith and Jones (2024) that X causes Y.'

Where Smith has co-authored their publication with more than one other person, t
Latin abbreviation for 'and others'.

For example,

'It has been previously shown that X causes Y (Smith *et al.*, 2024).'

or

'It has been previously shown by Smith *et al.* (2024) that X causes Y.'

A way of referencing your text without being disruptive to the flow is end-text refe
on some web pages, such as in Wikipedia articles. These references use small num
facts.

An end-text reference could look like this:

'It has been previously shown that X causes Y[1].'

The numbers start from 1 for the first time a reference is used and increase sequen
same article (even a different fact from it) is referenced later, its number is repeate

An example of this might be:

'It has been previously shown that X causes Y[1]. Some authors have disputed th
that Z is also a key variable[4]. However, X is known to be dependent on Z[1].'

Summary: key referencing points

- Use reliable sources (e.g. peer-reviewed journals, government reports).
- Cite sources within the text and in a reference list.
- Use the correct referencing format (Harvard or Vancouver).

Scientific articles also have a bibliography at the end, listing the full references alph

The full reference in the bibliography will give:

1. The author's or the editor's surname, and a comma
2. Their initial
3. The year of publication, in brackets
4. Title of text, in italics or quotation marks
5. Place of publication
6. Name of publisher

Correct and consistent use of the Harvard or Vancouver refe

There are different referencing styles used in scientific writing.

Mini-task

Find a scientific article and fill in the table below with the information from the re

Author(s)	Date published	Book publisher or journal name	

Harvard referencing (author-date format)

- **Example:** Smith, J., 2023. *The Science of Climate Change.* London: Science Pr

Vancouver referencing (numbered format)

- **Example:** Smith J. The science of climate change. London: Science Press; 202

I doubt that there is any useful information here [1].

All we know is limited, apart from knowing the answer we a
we? Wombat and Koala have discovered some interesting thing

Some people are too nosy. What can happen to them is desc
Lion [2, p. 9].

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of modern skepticism (2016).

Mini-task

Below are two examples of references – one in **Harvard** style and one in **Vancou**
Your task is to convert each reference into the opposite style.

1. **Convert the Harvard reference into Vancouver style:**

   Harvard:
   Smith, J., 2022. *The impact of microplastics on marine ecosystems. Marine Scien*

2. **Convert the Vancouver reference into Harvard style:**

   Vancouver:
   1. Johnson T, Patel R. Climate change and public health. *Lancet Planet Healt*

For further support: **zzed.uk/12837-Referencing**

Evidence to support conclusions / claims made

Scientific conclusions must be supported by credible evidence.

Key aspects of strong evidence:

- Reliable data from experiments.
- Multiple supporting studies.
- Logical reasoning connecting evidence to conclusions.

Skill-based question

27 Identify the evidence supporting the scientific claim that regular consump increases the risk of colorectal cancer.

Tips: **Step 1: Understand the claim**

- Identify the key components of the claim:
  - What is being studied? (Processed meat consumption)
  - What is the proposed effect? (Increased risk of colorectal cance
  - What is the relationship? (Causation or correlation?)

Step 2: Identify supporting evidence

- Look for research studies that test this claim.
- Consider data from reputable sources such as WHO, NHS, or scientif
- Use a table to summarise key studies:

Study title	Source (journal, organisation)	Sample size	Findin

Step 3: Evaluate the evidence

- How strong is the evidence?
  - Is it based on a large population study?
  - Are the findings consistent across multiple studies?
  - Is there any bias in the research?

Step 4: Consider counterevidence

- Are there studies that challenge or contradict the claim?
- Could there be other factors influencing colorectal cancer risk (e.g. g

Step 5: Write a conclusion

- Summarise the evidence for and against the claim.
- State whether the evidence strongly supports the claim or if further r

Critically evaluating evidence to support or refute conclusio

Scientific claims must be critically evaluated to determine their validity.

Critical evaluation checklist:

- Are the sources reliable?
- Was the study peer-reviewed?
- Are there conflicting studies?

Mini-case study

A now-debunked study falsely linked the MMR vaccine to autism, but critical eval no link.

Mini-task

Choose a recent scientific claim you've heard about (e.g. in the news or online).
Write 2–3 sentences explaining:

1. What the claim is.
2. One reason why it might be reliable or unreliable.

Considering why it is important for the public to understand

Scientific literacy is the ability to understand, evaluate and apply scientific informati
people to make informed decisions about their health, use of technology, and resp
challenges. In a world where science influences nearly every aspect of society, bein
individuals think critically, ask the right questions, and separate fact from fiction.

Key benefits of scientific literacy

1. **Understanding health risks**
   Being scientifically literate helps individuals to assess health information more
   - Vaccines: Understanding how vaccines work, their safety, and herd immun
     choices and avoid being misled by anti-vaccine myths.
   - Nutrition: Scientific literacy allows people to evaluate dietary claims (e.g.
     on evidence, not marketing.
   - Medical treatments: It also helps patients understand risks, benefits, and a
     treatments.

   Real-world example: During the development of the HPV vaccine, people wit
   were more likely to support its use to prevent cervical cancer.

2. **Recognising misinformation**
   Scientific literacy improves people's ability to spot misleading headlines, viral h
   on social media.
   - It encourages fact-checking, looking for credible sources, and questionin
     charged language.
   - This is especially important when scientific issues are politicised or oversi
     denial or pseudoscientific health products.

   Example: During the 'Climategate' controversy, those with higher scientific lite
   understand that the hacked climate emails didn't disprove global warming.

3. **Engaging in evidence-based policymaking**
   Scientific literacy allows individuals to participate meaningfully in public debat
   related issues.
   - This includes voting on or supporting policies related to clean energy, pu
     biodiversity conservation.
   - Citizens who understand scientific evidence can hold decision-makers acc
     solutions backed by research.

   Example: In local communities, public understanding of air pollution data can
   zones or low-emission transport policies.

Mini-task

Explain why scientific literacy is important for society.

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