Patterns of Change: Technology

Headings	Notes
WHAT IS TECHNOLOGY?	• **Technology** refers to tools, devices, or methods used to carry out specific tasks.
	• **Innovation** involves the introduction of new ideas, methods, or products that bring significant changes to society.
	• Throughout history, developments in technology have been among the primary drivers of change, influencing daily life, social structures, and global history.
TECHNOLOGY IN ANCIENT TIMES	• **Agricultural technology** was essential in securing a stable and nutritious food supply, starting with **farming**, which allowed the growth of human populations and the formation of settlements.
AGRICULTURAL INNOVATION	• The **Mesolithic Period** marked a time when humans were **hunter-gatherers**, relying on hunting and gathering plants, with a nomadic lifestyle that shifted with seasons or food availability.
	• The **Neolithic farmers** introduced early **cultivation** practices, growing crops and domesticating animals for dairy and meat, transforming diets and contributing to community stability.
	• With a **secure food supply**, communities expanded into towns and cities. **Food surplus** allowed people to specialize in other roles, including **metalworking**, **carpentry**, and **religious practices**.
	• Technological advances in **metalworking**, like the creation of **iron ploughs**, allowed for deeper soil cultivation, boosting agricultural productivity.
	• **Water supply systems** were established to provide cities with drinking water and to irrigate fields, keeping soil fertile and supporting agricultural expansion.
MANUFACTURING AND INDUSTRY	• Early human manufacturing involved creating essential objects like **tools, weapons, pots, homes, and clothes** from materials such as stone and wood.
	• During the **Bronze Age** in Ireland, the introduction of **bronze** (a combination of copper and tin) enabled the production of stronger, more easily shaped tools and weapons, advancing both industry and society.
	• **Copper** was mined locally (e.g., at **Mount Gabriel in Co. Cork**), while **tin** was imported from places like **Cornwall in Britain**.

Keywords	Summary
Technology Copper	
Innovation Mount Gabriel	
Agricultural technology	
Farming Tin	
Mesolithic Period	
Hunter-gatherers	
Neolithic farmers	
Metalworking Cornwall	
Bronze Age	
Alloy	

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MANUFACTURING AND INDUSTRY	**Smelting** was a key process in metalworking, involving the heating and melting of metals to separate them from ore, which allowed for the casting of metals into specific shapes using **moulds**. **Metalworkers**, or **smiths**, specialized in producing tools such as **sickles** (for harvesting crops), **axes**, **ploughs**, and weapons like **knives, swords, shields, and spears**. Despite these advancements, farming remained the primary occupation.
MILITARY TECHNOLOGY	- Throughout human history, conflict has necessitated the development of weapons and armour for protection and offense. - Early **warriors** used **swords, daggers, and spears** for close combat, along with **armour** and **shields** to defend against enemy attacks. - For long-range attacks, weapons such as **throwing spears, bows and arrows, and crossbows** were developed, initially crafted from stone and wood and later incorporating metals for enhanced durability. - As populations began to settle in fortified areas, **siege weapons** emerged to breach defensive walls; the Romans, in particular, created advanced machines like **catapults** to hurl projectiles (e.g., stones or metal balls) at fortified positions. - Roman dominance across the Mediterranean was largely due to their military innovations, **battlefield tactics**, and use of **iron weapons**, which allowed them to conquer and maintain vast territories for centuries.
IMPACT AND CONTRIBUTION OF ANCIENT TIMES	- Technological innovations during ancient times significantly shaped human society and development. **Agricultural advancements** such as crop cultivation and animal domestication created a reliable food supply, enabling the formation of stable, settled communities and the rise of early civilisations. - Developments in **metalworking** allowed the production of tools and weapons, which supported daily life, farming, and defence, and facilitated the expansion of communities. **Military innovations** like siege engines and battlefield tactics were instrumental in the growth of empires, especially for the Romans, whose military prowess enabled them to control vast territories.

Keywords	Summary
Smelting	
Metalworkers	
Smiths	
Warriors	
Siege Weapons	
Romans	
Celts	

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Headings	Notes
IMPACT AND CONTRIBUTION OF ANCIENT TIMES	• Ancient technology laid foundational principles for **city planning, agriculture, and defence**, influencing later civilisations and establishing structures that persist today.
TECHNOLOGY IN THE MIDDLE AGES	• The **feudal manor** system organised land into large fields and shaped medieval farming practices.
AGRICULTURAL INNOVATION	• The **open field system** divided land for crops into three large fields, each further split into long strips of land allocated to different families. • **Field One**: planted with **wheat** for making bread. • **Field Two**: planted with **oats** (for porridge) and **barley** (for beer). • **Field Three**: left **fallow** (unused) to allow the soil to regain nutrients. • **Commons** land was designated for **animal grazing**, a fourth large field used by all for communal livestock. • Despite these innovations, the system was inefficient as one-third of the land remained unused each year.
MANUFACTURING AND INDUSTRY	• **Blast furnaces** were introduced in medieval Europe, hundreds of years after their invention in China, showcasing how technological advances spread and evolved independently. • These furnaces produced **molten iron**, which could be poured into **moulds** to create **cast iron** tools and weapons, significantly improving the quality and strength of iron products. • Prior to this, iron tools and weapons were individually **hammered into shape**. The use of blast furnaces made high-quality iron implements more widely available.
MILITARY TECHNOLOGY	• Knights in medieval Europe used weapons and armour similar to those of **Roman legionaries** — **swords**, **plate armour**, and large **shields**. • **Steel** production techniques arrived in Europe from China, and although steel was harder and more durable than iron, it was costly, so only the wealthiest knights could afford steel weapons and armour. • Advances in military technology, including **steel weaponry** and improved armour, transformed combat tactics and were crucial in medieval warfare.

Keywords	Summary
Feudal manor	
Open field system	
Commons	
Blast furnaces	
Roman legionaries	
Steel	

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Headings	Notes
IMPACT AND CONTRIBUTION OF THE MIDDLE AGES	• **Medieval agricultural practices**, such as crop rotation, helped improve land productivity, supporting population growth and the development of feudal society.
	• The use of **blast furnaces** advanced metalworking, leading to stronger, more durable tools and weapons, which were crucial for both farming and warfare.
	• **Military technology** like steel weaponry and armour transformed combat, strengthening knights' role in warfare and castle defence.
	• Collectively, these technological advancements helped Europe transition from isolated communities to more interconnected societies with improved infrastructure, trade networks, and a stronger feudal system.
	• The innovations of the Middle Ages laid the groundwork for urban growth, the spread of trade, and the political and economic foundation that shaped Europe into the Renaissance period.
TECHNOLOGY IN THE RENAISSANCE ***AGRICULTURAL INNOVATION***	• The Renaissance introduced more efficient **crop rotation** methods that improved soil fertility and allowed for higher crop yields without leaving land fallow.
	• Farmers began planting **clover** and **legumes**, which helped **replenish nitrogen** in the soil, a key nutrient for plant growth.
	• **New plough designs**—such as the heavy, wheeled plough—enabled deeper, more effective cultivation, especially useful for northern Europe's heavy soils.
	• **Trade and exploration** brought new crops to Europe via the **Columbian Exchange**:
	• **Maize**, **potatoes**, and **tomatoes** from the Americas became staples in European diets.
	• **Potatoes**, with high nutritional value, helped increase population growth due to their adaptability in various climates.
COMMUNICATION TECHNOLOGY	• Prior to the 1400s, books were painstakingly **handwritten**, which made them costly and rare, limiting access to written knowledge.
	• **Johannes Gutenberg** invented the **movable type printing press**, allowing for quicker, cheaper production of books. His first printed work was the **Gutenberg Bible**.
	• The **printing press** made books accessible to more people, fostering **literacy** and encouraging the spread of **new ideas**. This weakened the **Catholic Church's** control over knowledge, as more people could read and disseminate ideas outside of church doctrine.

Keywords	Summary
Medieval Agricultural Practices	
Blast Furnaces	
Crop Rotation	
New Plough Designs	
Columbian Exchange	
Johannes Gutenberg	
Printing Press	
Gutenberg Bible	

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Headings	Notes
COMMUNICATION TECHNOLOGY	• Books began to be published in the **vernacular** (local languages) rather than in Latin, which helped spread **Renaissance** ideas across Europe.
NAVIGATIONAL TECHNOLOGY	• Before the **Age of Exploration**, sailors stayed close to shore, but new technologies made **oceanic navigation** possible. • **Cartographers** (mapmakers) began using **portolan charts** from Constantinople, which mapped coastlines, harbours, currents, tides, and depths more accurately. • Key navigational tools included: • **Quadrant** and **astrolabe** for determining latitude by measuring the positions of the sun and stars. • **Compass**, which used magnetism to indicate **north** and aid in direction-finding. • **Log and line** to measure a ship's speed in **knots.** • **Line and lead weight** to gauge water depth. • These advancements allowed European sailors to undertake longer, safer voyages, enabling exploration and conquest.
MILITARY TECHNOLOGY	• The invention of **gunpowder** originated from an accidental discovery by Chinese doctors, who mixed **sulphur** and **saltpetre** seeking to extend life. • **Gunpowder** changed the nature of warfare; **cannons** became standard siege weapons, able to destroy fortified city walls and transform naval battles. • Handheld **firearms** evolved over time, making battles more deadly and contributing to the success of European conquests, as in the case of the **Spanish conquest of the Aztecs and Incas**.
IMPACT AND CONTRIBUTION OF THE RENAISSANCE	• Renaissance agricultural innovations led to increased food production and population growth, setting the stage for further advancements in the Agricultural Revolution. • **Printing technology** revolutionised communication, making books affordable, increasing literacy, and promoting the spread of new ideas, thus weakening the Catholic Church's control over information.

Keywords	Summary
Vernacular	
Renaissance	
Age of Exploration	
Cartographers	
Quadrant	
Astrolabe	
Compass	
Gunpowder	
Aztecs	
Incas	

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Headings	Notes
IMPACT AND CONTRIBUTION OF THE RENAISSANCE	• Advances in **navigational technology** enabled European explorers to reach new continents, laying the foundation for global trade networks, conquest, and the colonisation of the Americas. • The invention of **gunpowder** and firearms shifted the balance of military power, allowing European states to expand through conquest and colonisation. • The technological progress of the Renaissance spurred scientific inquiry, exploration, and cultural shifts, contributing to the transformations of the Enlightenment and Age of Exploration.
TECHNOLOGY IN INDUSTRIAL SOCIETY **AGRICULTURAL INNOVATION**	• The **Norfolk system** developed by Charles Townshend involved a **four-crop rotation**: wheat, turnips, oats/barley, and clover/grass, which restored nutrients to the soil and increased food production. • **Enclosure** transformed farming by consolidating individual strips into large farms, fenced for efficiency, ending the open-field system. • **Selective breeding** by **Robert Bakewell** involved reserving the largest animals for breeding, leading to bigger and healthier livestock and increased meat availability. • **Jethro Tull's seed drill** allowed for efficient planting by sowing seeds at the correct depth in straight rows. • **Cyrus McCormick's mechanical reaper** mechanised crop harvesting, making it faster and less labor-intensive.
MANUFACTURING AND INDUSTRY	• The **Industrial Revolution** began in Britain, driven by innovations such as the **steam engine**. • **Thomas Newcomen's steam engines** were initially used to pump water from mines, with later improvements by **James Watt**, including a **flywheel** that allowed rotary motion, making it versatile for powering other machines. • Steam power was applied to **textile machinery** like Crompton's **spinning mule** and Cartwright's **power loom**, which accelerated cloth production and drove the growth of factories.

Keywords	Summary
Navigational Technology	
Gunpowder	
Norfolk System	
Enclosure	
Selective Breeding	
Seed Drill	
Mechanical Reaper	
Steam Engine	
Spinning Mule	
Power Loom	

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Headings	Notes
COMMUNICATION TECHNOLOGY	• **Friedrich Koenig's steam-powered printing press** in 1812 could print 1,100 sheets per hour, boosting mass media as newspapers could now be widely produced and distributed. • This cross-innovation, where **steam power** enhanced printing, allowed for quicker dissemination of information to the public.
NAVIGATIONAL TECHNOLOGY	• Steam engines also transformed transportation, initiating the **Railway Age**. • **Richard Trevithick** built the first steam-powered locomotive, and **George Stephenson's Rocket** operated on the Liverpool-Manchester line, marking the rise of **passenger railways.**
IMPACT AND CONTRIBUTION OF THE INDUSTRIAL	• Agricultural innovations like crop rotation, selective breeding, and mechanisation supported a rapidly growing population and enabled urban migration. • The **steam engine** powered factories, leading to mass production in industries such as textiles and contributing to the growth of industrialised cities. • Developments in **communication**, such as the steam-powered printing press, fostered mass media, enabling faster information dissemination to a wider audience. • The **railway** system transformed transportation, making it easier to move goods and people, facilitating trade, and connecting distant areas economically and culturally. • The Industrial Revolution marked a shift from agrarian to industrial societies, creating modern urban centres, spurring economic growth, and laying the groundwork for the capitalist economy.
TECHNOLOGY IN MODERN TIMES **AGRICULTURAL INNOVATION**	• A rapid increase in global population necessitated advancements in **agricultural technology** to feed more people. • The **internal combustion engine** replaced animals for farm work, leading to mechanised farming with tractors and combine harvesters, which freed land previously used to sustain working animals. • **Artificial fertilizers** developed in the early 20th century replenished soil nutrients, eliminating the need for crop rotation and enabling multiple crop yields per year. • The introduction of **pesticides** began with the development of synthetic insecticides in the 1920s, increasing crop protection and yield:

Keywords	Summary
Friedrich Koenig's	
Richard Trevithick	
George Stephenson's	
Steam Engine	
Railway	
Agricultural Technology	
Internal Combustion Engine	
Artificial Fertilizers	
Pesticides	

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Headings	Notes
AGRICULTURAL INNOVATION	• **Insecticides** combat pests, **fungicides** prevent plant diseases, and **herbicides** control weeds. • These advancements contributed to the **Green Revolution**, which spread these methods globally, reducing famine risks. • Mechanisation and higher food production led to urbanisation, with populations moving to cities as farm labour requirements declined.

MANUFACTURING AND INDUSTRY	• Although **steam engines** had driven 19th-century machines, they were large, labour-intensive, and prone to breakdowns. The **internal combustion engine** resolved these issues with its compact, efficient design.
	• **Karl Benz** developed the first automobiles in Germany in 1886, while **Henry Ford** in the USA introduced mass production via the **assembly line**, allowing large-scale, affordable car manufacturing.
	• **Assembly line production** meant workers remained in place while parts were brought to them, a system soon adopted in other industries worldwide.
	• **Electricity** became widely available in the 20th century, transforming daily life:
	  • **Lightbulbs** invented by **Thomas Edison** and **Nikola Tesla** replaced candles and lamps, making lighting safer and cheaper.
	  • **Power plants** supplied electricity for homes and businesses, enabling 24-hour factory operations and powering various new appliances.
	• Larger vehicles powered by internal combustion engines (e.g., **tractors** and **tanks**) enabled advances in agriculture, transport, and military technology.

MILITARY TECHNOLOGY	• **World War I** introduced new military technology such as:
	  • **Aeroplanes** for reconnaissance, aerial combat, and bombing.
	  • **U-boats** (German submarines) used for naval warfare, sinking military and civilian ships.
	  • **Tanks** invented by the British to break the trench warfare stalemate.
	  • **Chemical weapons** like chlorine gas and phosgene, which caused mass casualties and long-term injuries.
	  • **Shell shock**, now known as **PTSD**, affected soldiers exposed to intense, prolonged combat.

Keywords	Summary
Insecticides **Power plants** **fungicides** **tractors** **herbicides** **Aeroplanes** **Karl Benz** **Tanks** **Henry Ford** **Chemical weapons** **Assembly line** **Electricity** **PTSD** **Thomas Edison** **Nikola Tesla**	

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Headings	Notes
MILITARY TECHNOLOGY	• **World War II** advancements included:
	• Improved submarines and **torpedoes**, **ASDIC** (sonar), and **radar** for oceanic warfare.
	• **Aircraft carriers** as mobile airbases, allowing planes to refuel mid-sea.
	• Enhanced weaponry with **Tiger tanks** and **machine guns** like the German MG 42, firing 1,200 rounds per minute.
	• **Jet fighters** like the **Messerschmitt ME 262**, a German invention, and **long-range rockets** (e.g., the V1 and V2).
	• **The Atomic Bomb**: The US developed atomic bombs during the **Manhattan Project**, leading to devastating bombings of **Hiroshima** and **Nagasaki** in **1945**, causing mass civilian casualties and long-term radiation effects.
IMPACT AND CONTRIBUTION OF MILITARY	• World War technology advancements meant battles could shift quickly, as in **Blitzkrieg** tactics, with new weapons causing unprecedented destruction.
	• Civilian casualties increased, with WWII seeing approximately 38-55 million civilian deaths.
	• **Atomic bomb** invention introduced a new era of warfare with nuclear deterrence, profoundly shaping Cold War politics.
COMMUNICATION TECHNOLOGY	• The 19th and 20th centuries saw significant advances in **telecommunications** (electric-based communication systems), transforming how information was shared globally.
	• **Telegraph**: Invented in 1831, it enabled instant text-based communication over long distances through wired signals.
	• **Telephone**: Developed by **Alexander Graham Bell** in 1876, allowing real-time verbal communication via voice waves transmitted electronically.
	• **Radio**: Pioneered by **Guglielmo Marconi** in the 1890s, it became a household staple by the 1920s, providing news, weather, music, and entertainment.
	• **Television**: Emerging in the 1920s, television became the leading source of entertainment and information after WWII, with over 90% of American homes owning a TV by the mid-1950s.
	• Television shaped culture by broadcasting significant events (e.g., moon landing, social movements) directly into homes, helping drive social awareness and change.
	• **Mobile phones** emerged from satellite communication advances, allowing wireless verbal communication, followed by the **internet** in the 1980s, providing vast access to info and media.

Keywords	Summary
Asdic **Radar**	
Aircraft Carriers	
Tiger Tanks **Machine Guns**	
Jet Fighters **Rockets**	
Atomic Bomb **Blitzkrieg**	
Telegraph **Telephone**	
Radio **Television**	
Mobile Phone **Internet**	

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Headings	Notes
NAVIGATIONAL TECHNOLOGY	• **The Space Race** during the Cold War era led to groundbreaking technological innovations as the US and Soviet Union competed in scientific exploration and military technology. • **Sputnik**: Launched by the Soviet Union in 1957, the first artificial satellite, sparking US fears of a **missile gap**. • **Explorer**: In 1958, the US successfully launched its first satellite, restoring national confidence. • **The Moon Landing**: US President John F. Kennedy set the goal to land on the moon, achieved by **NASA's Apollo 11 mission** in 1969. • **Neil Armstrong** and **Buzz Aldrin** became the first humans to walk on the moon, watched by over 500 million people globally, marking a US victory in the space race and symbolising technological prowess. • Space race technology spurred innovations in **satellites**, **communication**, and **computing**, influencing both military and civilian life.
IMPACT AND CONTRIBUTION OF MODERN TIMES	• **Agricultural innovations** such as mechanisation and chemical usage met the food demands of a rapidly growing global population, contributing to urban migration and reducing the risk of famine. • **Manufacturing advancements** through the internal combustion engine and mass production expanded consumer goods availability, making technology accessible to the broader public and transforming everyday life. • **Military technologies** introduced in the world wars redefined global power structures and led to devastating impacts on civilian and military populations, with the atomic bomb setting a new precedent for potential destruction. • **Communication breakthroughs** from radio and television to the internet enabled real-time global connection, reshaping media, culture, and social dynamics. • **Space race** achievements accelerated technological progress in navigation, computing, and satellite technology, continuing to influence modern innovation and geopolitical competition.

Keywords	Summary
Space Race	
Sputnik	
Missile gap	
Explorer	
The Moon Landing	
NASA	
Apollo 11	
Neil Armstrong	
Buzz Aldrin	

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Keywords	Definitions
Arms Race	• A race between the USA and the USSR (Soviet Russia) and their allies to compete for superiority in military arms, often referred to during the Cold War.
Cold War	• Period of hostility between the USA and its allies and the Soviet Union and its allies that lasted from the end of World War II to the collapse of Communism in the early 1990s.
Historical Change	• Changes that happen in history; how differences occur in history through causes and effects (consequences).
Industrial Revolution	• Rapid industrial growth or change that began in the middle of the 18th Century and brought about the factory system and the growth of cities.
Innovation	• Any new idea, method or product that brings about change.
Navigation	• Directing or guiding a ship from one place to another
Nuclear War	• A war fought with atomic and hydrogen (nuclear) bombs
Standardisation	• Developing the same basic features e.g. in the English language
Technological Developments	• The practical use or application of methods and machines to produce goods and services in mass production.
Technology	• The tools, devices or means to carry out tasks.