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CONCEPTS IN THE REAL WORLD

AIR TRAVEL

The following highlights numerous links between the *Atlas of Human Imagination* and air travel:

- Imhotep's pyramid structures are early precursors to the large, load-bearing, concrete architectural structures we now see in all our airports
- Homer's epic storytelling emphasised human flight, later sparking experimentation with gliders, balloons and ultimately aircraft
- Thales's work on geometry and trigonometry underpins the whole of navigation and triangulation of aircraft
- Pythagoras's theorem is used every second of the day calculating distances, altitude, glide paths and descents for all aircraft

- Confucius's teachings have a strong bearing on ethics, safety culture, hierarchy and good management to keep airlines safe and in-check
- Democritus's atomic theory is a crucial concept that helps us understand chemical combustion of fuels and development of aircraft materials
- Plato's geometrical work gives all aviation, aerodynamics and aircraft design a solid mathematical footing
- Archimedes's work on buoyancy, levers, screws and centre of mass are all key physical phenomena for aircraft systems and flying in general
- Eratosthenes's calculation of Earth's circumference and axial tilt are fundamental numbers needed for the whole airline industry
- Brahmagupta's concept of zero is essential to aviation in calculating everything from flight trajectory and altitude, to an airline's profit or loss
- Al-Khwarizmi's mathematics is used every day in aviation in the form of computer algorithms for flight and safe navigation
- Alhazen's work on human optics is essential for vision systems for pilots and air traffic controllers, as well as windows and cockpit design
- Fibonacci's introduction of decimal numerals permitted precise mathematical calculations and efficient rapid computation
- Al-Jazari's robotic devices were early precursors to the sensors, actuators, motors and auto-pilot systems used in aircraft today
- Henry the Navigator's concepts emphasised the importance of accurate maps, astronomy, navigation and planning in global travel
- Gutenberg's printing press helped share information amongst scientists to accelerate learning and all scientific studies
- Da Vinci's bird studies, mechanical wings, gliders, helicopter designs and birds-eye maps helped bring about the strong human desire to fly
- Nunes's navigational mathematics is the basis of the great circle which pilots use today to fly the shortest distances between A and B
- Mercator's map projections are the foundation of today's flight planning, by plotting map courses and headings over long distances

- Gilbert's geomagnetism breakthrough is still important for compass-based navigation and backup systems in aircraft
- Galileo's appreciation of gravity, freefall, projectile motion and inertia are all fundamental to modern aviation systems
- Bacon's scientific method triggered the empirical approach that then guided the Wright Brothers and all subsequent aerospace engineers
- Harvey's work on blood circulation is relevant today when studying cardio-physiology and deep vein thrombosis of pilots, crew and passengers
- Descartes's XYZ coordinate systems allow aircraft to be positioned and tracked in the skies with accuracy and predictability
- Pascal's mathematical physics are crucial for fluid flow, nozzles, pumps, altimeters, pitot tubes and pressure sensors, ultimately making aircraft safe
- Huygens's wave theory is used today in optical sensors, radar and all kinds of communication and navigation instruments
- Leeuwenhoek's microscope, and their modern-day equivalents, are used to analyse aircraft materials and inspect components for safety
- Newton's laws of motion, gravitation and calculus are at the very heart of successful aircraft design and weight-lift-thrust-drag diagrams
- Euler's equations are still used in rigid body mechanics of airframes, as well as fluid flow in aerodynamic design for wings and fuselages
- Lavoisier's conservation of mass is still critical for fuel combustion and the chemical processes involved in aviation
- Watt's principle of turning combustion into mechanical rotation was the basis of the first aircraft propulsion
- Smith's economic principles are relevant today in factories constructing aircraft and the many airline companies that operate today
- Blake's poetic imagery of flight, wings, freedom and elevated perspectives gave us philosophical desires to conquer the skies
- Jenner's inoculation studies gave us vaccines to fight COVID-19 which re-opened the aviation industry and global travel in the 2020s

- Volta's first electrochemical battery was the precursor to all lithium-ion batteries on aircraft today
- Gauss's work on geomagnetism and mathematics are used in compass calibration, navigational safety and avionics
- Berzelius's chemical notation is essential to all developments of fuels, aircraft and jet engine materials
- Faraday's work on electromagnetism is used in all motors, wing-actuators, generators, APUs and electrical systems in aircraft and on the ground
- Lovelace's first algorithms were precursors to flight simulation, aerodynamics, autopilot systems and avionics software
- Joule's conservation of energy concept is incredibly relevant to propulsion, which turns chemical energy into mechanical energy to generate lift
- Boole's algebraic logic is still used in every computer system today, from autopilot to online booking software
- Kelvin's temperature scale and thermodynamic laws underpin engine efficiency, propulsion systems and metrology
- Tyndall's atmospheric studies explain light scattering in the sky and the effects of pollution from aircraft contrails, particulates and emissions
- Kirchhoff's electrical laws underpin the design of radios, transponders, radar circuits and aircraft electronics
- Pasteur's germ theory helps prevent disease spread at airports and onboard flights, as well as sterilisation of cabin food, drinks and cutlery
- Clausius's entropy is used in understanding combustion of kerosene fuel and the efficiency of jet engines that power aircraft
- Mendeleev's periodic table led to new discoveries in fuels, and the metals, alloys and ceramics crucial for aircraft and jet engine construction
- Verne's adventures included imaginary airships, flying machines and rapid global travel, stimulating the strong appetite for human flight
- Maxwell's equations are still used in all radio and microwave transmission for communication and radar stations to track flights globally

- Tesla's AC electrical systems provide power to all airports and onboard electrical power systems throughout the world
- Nansen's pioneering studies of polar weather and wind patterns are still relied upon today for transatlantic flights flying over the Arctic circle
- Arrhenius's predictions about CO_2 levels raised early concerns about the impact of fossil fuel consumption on climate change
- The Wright brothers' bold ingenuity and their first human-flight gave birth to the entire aviation industry as we know it
- Einstein's relativity theory gave rise to GPS systems that provide accurate positioning and flight navigation across the globe
- Poincaré's chaos theory underpins flight planning, trajectory optimisation and air traffic flow management
- Gropius's Bauhaus movement and "*form follows function*" mantra helped design everything from aircraft to airports to airline branding
- Marconi's radio communication is still used in every aircraft in the world for wireless signals from air-to-ground
- Turing's universal computation is the blueprint of all computing, underpinning the whole aviation industry and beyond
- Picasso's *Guernica* painting depicts the horrors of wartime aerial bombardment and the dangers of technology in the wrong hands
- von Neumann's stored-programme computer architecture is still the main system used in all modern computers, including in all aircraft
- Bardeen's transistor switch is the electronic backbone of every computer in every flying aircraft, as well as on ground
- Shannon's concepts support air-to-ground radio, channel capacity, signal-to-noise and redundancy in aircraft communications
- Buckminster Fuller's paradigm for airframe efficiency and "*doing more with less*" remains an important part of light aircraft design
- Feynman's physics know-how underpins computational fluid dynamics (CFD) for aircraft design, as well as failure investigations

- Hopper's programming languages and compilers are still the basis of all aircraft computer systems today
- Huxley's *Brave New World* imagined a future society where people mainly commute in air-taxis and helicopters, before they even existed
- Warhol made numerous pieces of art related to modern aviation, showing propeller planes, celebrities flying, and even air crashes e.g. his piece "*129 Die in Jet!"*
- The Beatles' tours around the world symbolised postwar globalisation, connecting East and West, and fashion and technology
- Goodall's work in Africa relied upon aircraft and she pioneered the use of planes and drones for conservation and anti-poaching patrols
- von Braun's space programmes gave new lightweight materials for aircraft, such as aluminium, titanium, magnesium and carbon
- Lovelock's novel research involved measuring airborne pollutants directly from aircraft, which later led him to conceive *Gaia*
- Mandelbrot's fractals are relevant to weather and turbulence prediction in clouds to help aircraft fly safely through the skies
- Berners-Lee's creation of the internet underpins everything related to online flight booking, airline operations and communication
- Hinton's AI neural networks are regularly used for booking systems, flight operations and fuel efficiency calculations
- Hadid's airports, notably Beijing and Mumbai International, are testimony to her contribution to architecture in the aviation industry