Science & Technology Notes (General Awareness 2025)

1. Introduction to Science & Technology

Science is the systematic study of the natural world through observation and experimentation, leading to the development of technology—tools, systems, and processes that apply scientific knowledge to solve problems and improve lives. For competitive exams (UPSC, SSC, CBSE), Science & Technology covers basic principles (physics, chemistry, biology), recent advancements, and India's contributions.

Importance: Understanding S&T helps analyze global trends, innovations, and policies. It's a key component of General Awareness, with 5–10 questions in exams like UPSC Prelims, SSC CGL, and CBSE Class 10.

2. Key Areas of Science

2.1 Physics

Physics studies matter, energy, and their interactions.

- **Mechanics**: Motion, force, energy (e.g., Newton's Laws).
- **Thermodynamics**: Heat, energy transfer (e.g., laws of thermodynamics).
- **Electromagnetism**: Electricity, magnetism (e.g., Faraday's Law).
- **Optics**: Light behavior (e.g., reflection, refraction).
- **Modern Physics**: Quantum mechanics, relativity (e.g., Einstein's $E=mc^2$).

> **Example 1**: Why do objects fall to the ground?
>
> Due to gravity, a force pulling objects toward Earth's center (9.8 m/s^2). **Answer**: Gravity.

2.2 Chemistry

Chemistry explores matter's composition, properties, and reactions.

- **Atomic Structure**: Atoms, molecules, elements (e.g., periodic table).
- **Chemical Reactions**: Types (e.g., combustion, oxidation).
- **Organic Chemistry**: Carbon compounds (e.g., hydrocarbons).
- **Inorganic Chemistry**: Minerals, metals (e.g., sodium chloride).
- **Environmental Chemistry**: Pollution, green chemistry.

> **Example 2**: What gas, discovered on the sun before Earth, is the second most abundant element?
>
> Helium, discovered via solar spectroscopy in 1868. **Answer**: Helium.

2.3 Biology

Biology studies living organisms and their processes.

- **Cell Biology**: Cell structure, functions (e.g., nucleus, mitochondria).
- **Genetics**: DNA, heredity (e.g., Mendel's laws).
- **Ecology**: Ecosystems, biodiversity.
- **Human Physiology**: Organ systems (e.g., respiratory, circulatory).
- **Biotechnology**: Genetic engineering, vaccines.

> **Example 3**: What molecule carries genetic information?
>
> Deoxyribonucleic Acid (DNA). **Answer**: DNA.

3. Technology: Definition and Scope

Technology applies scientific knowledge for practical purposes, impacting communication, healthcare, energy, and more.

- **Information Technology**: Computers, internet, AI.
- **Biotechnology**: GMOs, gene therapy.
- **Energy Technology**: Solar, wind, nuclear.
- **Space Technology**: Satellites, missions.
- **Nanotechnology**: Materials at atomic scale.

4. Recent Advancements (2024–2025)

4.1 Artificial Intelligence (AI)

AI involves machines mimicking human intelligence.

- **Applications**: Healthcare (diagnostics), finance (fraud detection), autonomous vehicles.
- **India's AI Push**: National AI Strategy 2024, AI Mission (₹10,000 crore budget).
- **Global Trends**: ChatGPT, Google Bard, AI ethics debates.

> **Example 4**: Name an Indian AI initiative launched in 2024.
>
> IndiaAI Mission, aiming to boost AI innovation. **Answer**: IndiaAI Mission.

4.2 Space Technology

Space exploration advances scientific knowledge and national pride.

- **India's Achievements**:
  - **Chandrayaan-3 (2023)**: Successful lunar landing at south pole.
  - **Aditya-L1 (2024)**: India's first solar observatory mission.
  - **Gaganyaan (2025)**: India's first manned mission, planned for 2025.
- **Global**: NASA's Artemis, SpaceX Starship.

> **Example 5**: What was India's first solar mission?
>
> Aditya-L1, launched in 2024. **Answer**: Aditya-L1.

4.3 Biotechnology

Biotech advances healthcare and agriculture.

- **CRISPR**: Gene editing for disease treatment (e.g., sickle cell anemia).
- **Vaccines**: India's COVAXIN, mRNA vaccine research.
- **GM Crops**: Bt Brinjal, mustard (controversial in India).
- **India's Role**: Biotech Park, Hyderabad; BIRAC initiatives.

> **Example 6**: What technology edits genes precisely?
>
> CRISPR-Cas9. **Answer**: CRISPR.

4.4 Renewable Energy

Focus on sustainable energy sources.

- **Solar**: India's 100 GW solar target by 2030.
- **Wind**: Offshore wind projects (Gujarat, Tamil Nadu).
- **Green Hydrogen**: National Hydrogen Mission (2021).
- **Global**: Europe's wind farms, China's solar dominance.

> **Example 7**: What is India's green hydrogen initiative?
>
> National Hydrogen Mission. **Answer**: National Hydrogen Mission.

4.5 Quantum Technology

Quantum tech uses quantum mechanics for computing, communication.

- **India's Efforts**: National Quantum Mission (2023, ₹6,000 crore).
- **Applications**: Secure communication, quantum computing.
- **Global**: Google's quantum supremacy, China's quantum satellite.

> **Example 8**: Name India’s quantum tech initiative.
>
> National Quantum Mission. **Answer**: National Quantum Mission.

5. Indian Contributions to S&T

India is a global leader in S&T, with ISRO, DRDO, and research institutes driving innovation.

- **ISRO**: Chandrayaan, Mangalyaan, 104 satellites in one launch (2017).
- **DRDO**: Agni-V missile, Tejas aircraft.
- **Pharma**: World’s pharmacy; affordable generics, vaccines.
- **IT**: Bengaluru as Silicon Valley; TCS, Infosys.
- **Science**: Raman Effect (C.V. Raman, Nobel 1930), Bose-Einstein statistics.

> **Example 9**: Who discovered the Raman Effect?
>
> Sir C.V. Raman (1930 Nobel Prize). **Answer**: C.V. Raman.

6. Recent S&T Current Affairs (2024–2025)

- **AGNIT Semiconductors (2025)**: Won IESA Technovation Startup Award for Gallium Nitride tech. [](https://testbook.com/current-affairs/awards-and-honours-current-affairs)
- **HIMASHIELD 2024**: C-DAC’s challenge on Glacier Lake Outburst Flood mitigation. [](https://testbook.com/current-affairs/awards-and-honours-current-affairs)
- **Global Bio-India 2024**: Held in New Delhi, showcasing biotech research. [](https://www.gktoday.in/quizbase/important-days-and-events-current-affairs)
- **Deep Ocean Mission**: NCPOR’s new vessel for mineral exploration. [](https://www.gktoday.in/quizbase/india-government-politics-current-affairs)
- **5G Expansion**: India’s 5G rollout by Jio, Airtel, covering 98% districts by 2025.

> **Example 10**: Where was Global Bio-India 2024 held?
>
> New Delhi. **Answer**: New Delhi.
>
> [](https://www.gktoday.in/quizbase/important-days-and-events-current-affairs)

7. Key Scientific Concepts for Exams

Concept	Description	Example
Newton's Third Law	For every action, an equal and opposite reaction.	Rocket propulsion.
Photosynthesis	Plants convert CO_2 and sunlight into glucose.	$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$.
Periodic Table	Organizes elements by atomic number.	Hydrogen (1), Oxygen (8).
DNA Replication	DNA copies itself before cell division.	Ensures genetic continuity.
Ohm's Law	V = IR (Voltage = Current × Resistance).	Electrical circuits.

8. Technology Applications

- **Healthcare**: Telemedicine, robotic surgery, wearable devices.
- **Agriculture**: Drones for crop monitoring, GM seeds.
- **Communication**: 5G, satellite internet (Starlink).
- **Environment**: Carbon capture, biodegradable plastics.
- **Defense**: Drones, missile systems (BrahMos).

> **Example 11**: Name a technology used in precision agriculture.

> Drones for crop monitoring. **Answer**: Drones.

9. Indian S&T Institutions

- **ISRO**: Space research, Bengaluru.
- **DRDO**: Defense research, Delhi.
- **CSIR**: Scientific research, 38 labs across India.
- **IITs/IISc**: Technology, research (e.g., IIT Delhi ranked 123 globally, 2025). [](https://testbook.com/current-affairs)
- **ICMR**: Medical research, vaccine development.

> **Example 12**: Which body leads India's space missions?
>
> Indian Space Research Organisation. **Answer**: ISRO.

10. Emerging Technologies

- **Metaverse**: Virtual reality ecosystems for work, gaming.
- **Blockchain**: Secure transactions, cryptocurrencies.
- **6G**: Next-gen communication, expected by 2030.
- **Robotics**: Automation in manufacturing, healthcare.
- **IoT**: Internet of Things for smart cities, homes.

> **Example 13**: What technology secures cryptocurrency transactions?
>
> Blockchain. **Answer**: Blockchain.

11. S&T in Everyday Life

Science and technology impact daily activities:

- **Smartphones**: Use semiconductors, touchscreens, GPS.

- **Internet**: Fiber optics, cloud computing.
- **Healthcare**: MRI, vaccines, telemedicine.
- **Transport**: Electric vehicles, GPS navigation.
- **Home**: Smart appliances, solar panels.

> **Example 14**: What technology enables real-time navigation?
>
> Global Positioning System (GPS). **Answer**: GPS.

12. S&T and Environment

Technology addresses environmental challenges:

- **Renewable Energy**: Reduces CO_2 emissions.
- **Waste Management**: Recycling tech, biodegradable materials.
- **Monitoring**: Satellites track deforestation, pollution.
- **Green Tech**: Electric vehicles, carbon capture.

> **Example 15**: Name a technology reducing vehicle emissions.
>
> Electric vehicles (EVs). **Answer**: Electric vehicles.

13. Challenges in S&T

- **Ethical Issues**: AI bias, gene editing concerns.
- **Digital Divide**: Access to tech in rural India.
- **Cybersecurity**: Data breaches, hacking.
- **Funding**: Limited R&D budget (~0.7% of GDP in India).
- **Brain Drain**: Scientists migrating abroad.

> **Example 16**: What is a major challenge in AI development?
>
> Ethical concerns like bias in algorithms. **Answer**: AI ethics.

14. India’s S&T Policies

- **Science, Technology, Innovation Policy (STIP) 2020**: Aims for self-reliance, global leadership.
- **National Quantum Mission (2023)**: ₹6,000 crore for quantum tech.
- **IndiaAI Mission (2024)**: AI hubs, skill development.
- **Space Policy 2023**: Encourages private sector (e.g., Skyroot, Agnikul).
- **Biotech Policy**: Promotes R&D, startups via BIRAC.

> **Example 17**: What policy promotes India’s AI development?
>
> IndiaAI Mission. **Answer**: IndiaAI Mission.

15. Global S&T Trends

- **Climate Tech**: Carbon capture, green hydrogen.
- **Space Race**: China’s Tiangong, NASA’s Artemis.
- **Health Tech**: mRNA vaccines, wearable diagnostics.
- **Cybersecurity**: Quantum encryption, AI-based threat detection.
- **Metaverse**: VR/AR for education, work.

> **Example 18**: What technology powers mRNA vaccines?
>
> Messenger RNA (mRNA). **Answer**: mRNA.

16. S&T in Competitive Exams

Questions focus on basics, recent developments, and Indian contributions.

- **UPSC**: 5–10 questions on missions (e.g., Chandrayaan), policies.
- **SSC**: Basics (Newton’s Laws, DNA), inventions.
- **CBSE Class 10**: NCERT-based (e.g., photosynthesis, electricity).

- **Banking**: Tech applications (e.g., UPI, 5G).

17. Key Diagrams

Practice these for exams:

- **Atomic Structure**: Nucleus, electrons.
- **Photosynthesis**: Chloroplast, inputs/outputs.
- **Electric Circuit**: Series/parallel, components.
- **DNA Structure**: Double helix, base pairs.
- **Solar System**: Planets, orbits.

18. Practice Questions (1–20)

1. What is the SI unit of force?
2. Name the process by which plants make food.
3. What gas, used in balloons, is inert?
4. What is India’s first manned space mission?
5. Name a gene-editing technology.
6. What is the primary source of energy for Earth?
7. Which organization developed COVAXIN?
8. What technology enables secure digital transactions?
9. Name India’s solar mission launched in 2024.
10. What is the second law of thermodynamics?
11. Who invented the telephone?
12. What is the chemical formula for water?
13. Name a renewable energy source promoted in India.
14. What is the function of mitochondria in cells?
15. Which Indian scientist won the Nobel Prize in Physics?
16. What is the National Quantum Mission’s goal?
17. Name a technology used in smart cities.
18. What causes the greenhouse effect?
19. Which ISRO mission landed on the moon’s south pole?
20. What is the primary component of natural gas?

19. Practice Questions (21–40)

21. What is the IndiaAI Mission’s purpose?
22. Name a DRDO-developed missile.
23. What technology monitors crop health?
24. Which element has the atomic number 1?
25. What is the Raman Effect?
26. Name a global space mission targeting the moon.
27. What is the role of chlorophyll in plants?
28. Which policy promotes private space startups in India?
29. What is the main source of solar energy?
30. Name a biotech park in India.
31. What is Ohm’s Law?
32. Which gas is used in refrigeration?
33. What is the National Hydrogen Mission?
34. Name a challenge in AI development.
35. What is the function of a semiconductor?
36. Which institute leads India’s biotech research?
37. What is 5G technology?
38. Name a scientist associated with quantum mechanics.
39. What is the purpose of carbon capture technology?
40. Which Indian city is called the Silicon Valley of India?

20. Solutions

1. Newton (N).
2. Photosynthesis.
3. Helium.
4. Gaganyaan.
5. CRISPR.
6. Sun.
7. Bharat Biotech.

8. Blockchain.
9. Aditya-L1.
10. Entropy of an isolated system increases.
11. Alexander Graham Bell.
12. H_2O.
13. Solar energy.
14. Powerhouse of the cell (ATP production).
15. C.V. Raman.
16. Advance quantum computing, communication.
17. Internet of Things (IoT).
18. Greenhouse gases trap heat.
19. Chandrayaan-3.
20. Methane (CH_4).
21. Promote AI innovation, skill development.
22. Agni-V.
23. Drones.
24. Hydrogen.
25. Light scattering by molecules.
26. Artemis (NASA).
27. Absorbs light for photosynthesis.
28. Space Policy 2023.
29. Sunlight.
30. Hyderabad Biotech Park.
31. V = IR.
32. Ammonia (NH_3).
33. Promote green hydrogen production.
34. AI ethics/bias.
35. Controls electrical flow.
36. DBT/BIRAC.
37. Next-gen mobile communication.
38. Max Planck.
39. Reduce CO_2 emissions.
40. Bengaluru.

21. Study Tips

- **NCERTs**: Read Class 6–10 Science NCERTs for basics.
- **Current Affairs**: Follow The Hindu, Testbook PDFs for updates. [](https://testbook.com/current-affairs)
- **Diagrams**: Practice atomic structure, circuits, DNA.
- **Revise Inventions**: Memorize key inventors (e.g., Bell, Edison).
- **Mock Tests**: Solve UPSC/SSC past papers for S&T questions.

22. Revision Strategy

- **Daily**: Read one S&T news article (e.g., ISRO updates).
- **Weekly**: Revise one subtopic (e.g., physics laws).
- **Monthly**: Solve 50 MCQs on S&T.
- **Flowcharts**: Create charts for missions, policies.
- **Group Study**: Discuss recent advancements (e.g., AI, quantum).