

Dr. S. R. Shankapal

SUSTAINABLE FUTURES

Opportunities and Innovations
for a Changing World

Sustainable Futures

2020

CONCEPTUAL

1234567890

1234567890



Igniting Innovation, Inspiring Transformation

Preface

The world today faces a complex web of challenges that are both local and global in nature. From the depletion of natural resources and the lack of basic amenities to the far-reaching effects of climate change, economic disparities, and social inequities, these issues demand urgent and sustainable solutions. With the global population projected to rise from 7.32 billion to 9.5 billion by 2050, the scale of these problems will only intensify. Addressing these challenges is no longer optional; it is imperative.

One of the primary objectives of university education is to prepare graduates who can tackle these real-world challenges with innovative, affordable, and sustainable solutions. However, the role of universities extends beyond education—they are incubators of ideas and catalysts for change. By fostering creativity, interdisciplinary collaboration, and problem-solving skills, universities can empower students and researchers to translate societal challenges into opportunities for innovation and impact.

Preface

This book, "**Sustainable Futures: Opportunities and Innovations for a Changing World**," aims to inspire educators, researchers, and students to engage with the pressing problems of our time. It highlights specific challenges—with a focus on India and global contexts—and identifies numerous opportunities to develop business propositions that address these issues sustainably. From renewable energy and waste management to social equity and security, the book emphasizes the potential to align technological advancements with societal needs.

The objective is twofold: to motivate the academic community to reimagine their role in driving change and to encourage the development of solutions that are not only practical but also economically viable. By fostering an entrepreneurial mindset and focusing on sustainable development, we can create a future where innovation serves both humanity and the planet.

Preface

As we confront the challenges of a rapidly evolving world, let this book serve as a guide and a source of inspiration. Together, academia, industry, and society have the power to transform challenges into opportunities and build a sustainable future. The journey begins with education and the courage to innovate.

Dr. S. R. Shankapal

Content

1. Life's Desires
2. Brief History of World
3. The World At Present
4. India At Present
5. Problems To Be Solved

Life's Desires



Every human being desires to Live in a Developed Society/Nation



Because a Developed Society /Nation will be able to meet his /her needs and provides ample opportunities to realise his/her dreams

Maslow's Hierarchical Needs

Level	Description	Examples	Impact	Responsibility
Physiological Needs	Basic needs for survival	Food, water, air, shelter, sleep	Without these, survival is impossible, and higher needs cannot be addressed.	A Developed Society and Good Culture Essential
Safety Needs	Protection and stability	Safe living environment, financial security, health, protection from harm	Provides a sense of stability and reduces stress.	A Developed Society and Good Culture Essential
Love and Belonging	Relationships and connection	Friendships, family, romantic relationships, community	Fulfills the need for connection, reducing loneliness and alienation.	Good Culture Essential
Esteem Needs	Self-worth and recognition	Achievements, competence, self-confidence, respect from others	Enhances motivation, independence, and a sense of accomplishment.	Good Economy-Essential
Self-Actualization	Personal growth and fulfillment	Pursuing talents, achieving personal goals, creativity, realizing potential	Leads to purpose, fulfillment, and the ability to contribute meaningfully to society.	Good Economy-Essential

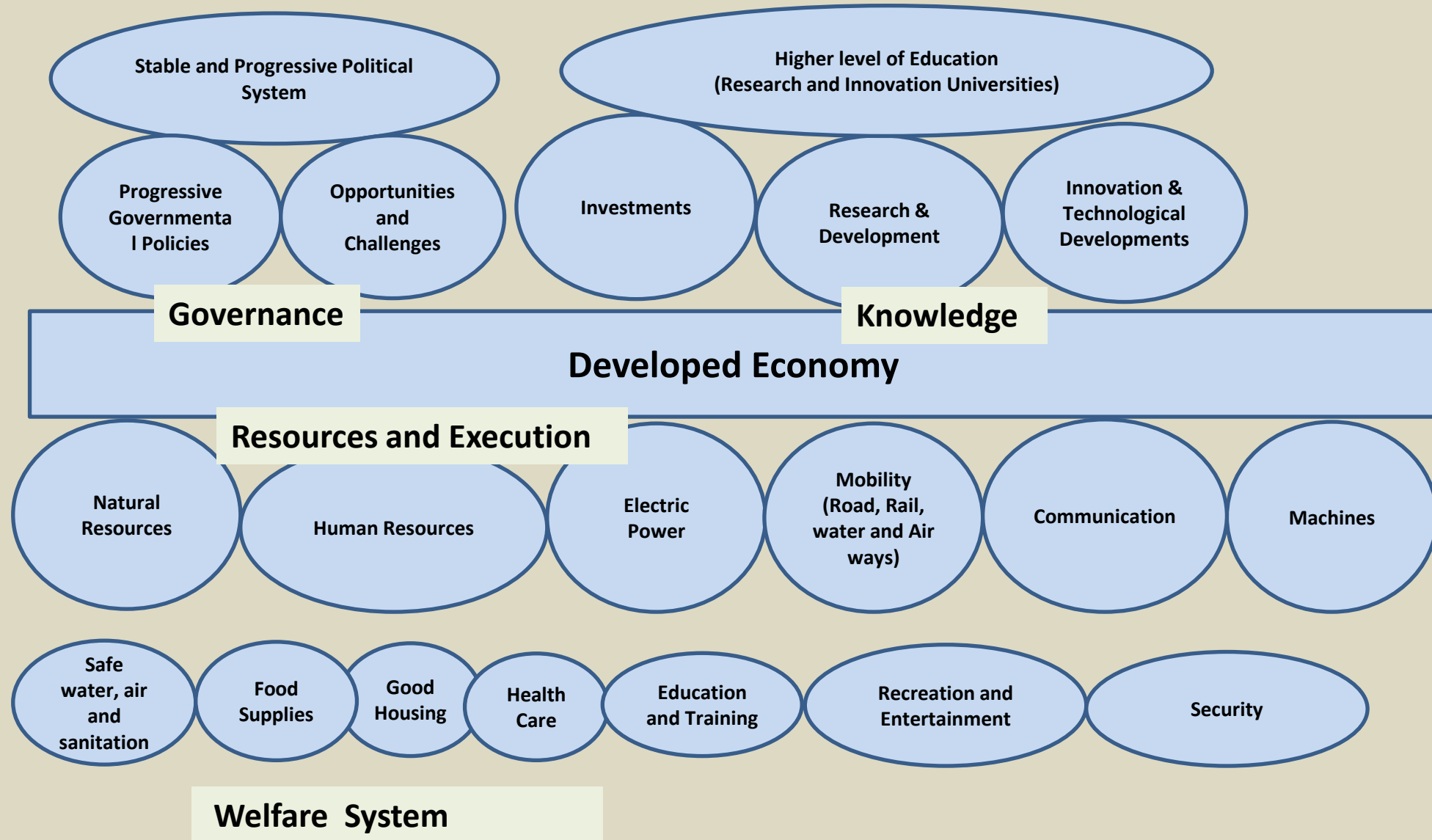
Attributes of a Developed Society

Component	Key Features	Indicators
Economic Stability	High GDP per capita, low unemployment, diversified industries, access to financial services	Standard of living, income equality, trade balance
Education and Knowledge	High literacy rates, accessible quality education, emphasis on research and innovation	Enrollment rates, academic performance, R&D investment
Health and Well-Being	Accessible healthcare, high life expectancy, focus on mental and physical health	Life expectancy, healthcare infrastructure, public health programs
Infrastructure and Urban Development	Reliable transportation, sustainable housing, efficient energy systems	Quality of infrastructure, urbanization rates
Governance and Political Stability	Transparent governance, strong rule of law, political stability, protection of human rights	Corruption index, political freedom, public trust in institutions
Social Equity and Inclusion	Equal opportunities, strong social safety nets, promotion of diversity	Gender equality index, income distribution, social mobility
Technological Advancement	Widespread technology use, strong digital infrastructure, support for innovation	Internet penetration, technological readiness, R&D spending
Environmental Sustainability	Renewable energy focus, resource conservation, policies on climate change and pollution	Carbon footprint, biodiversity index, recycling rates
Cultural and Ethical Values	Promotion of arts and heritage, ethical governance and business practices, community engagement	Cultural activities, ethical indices, volunteerism rates
Global Engagement	Participation in global trade and diplomacy, contributions to international development, open borders	Trade volume, foreign aid contributions, global partnerships

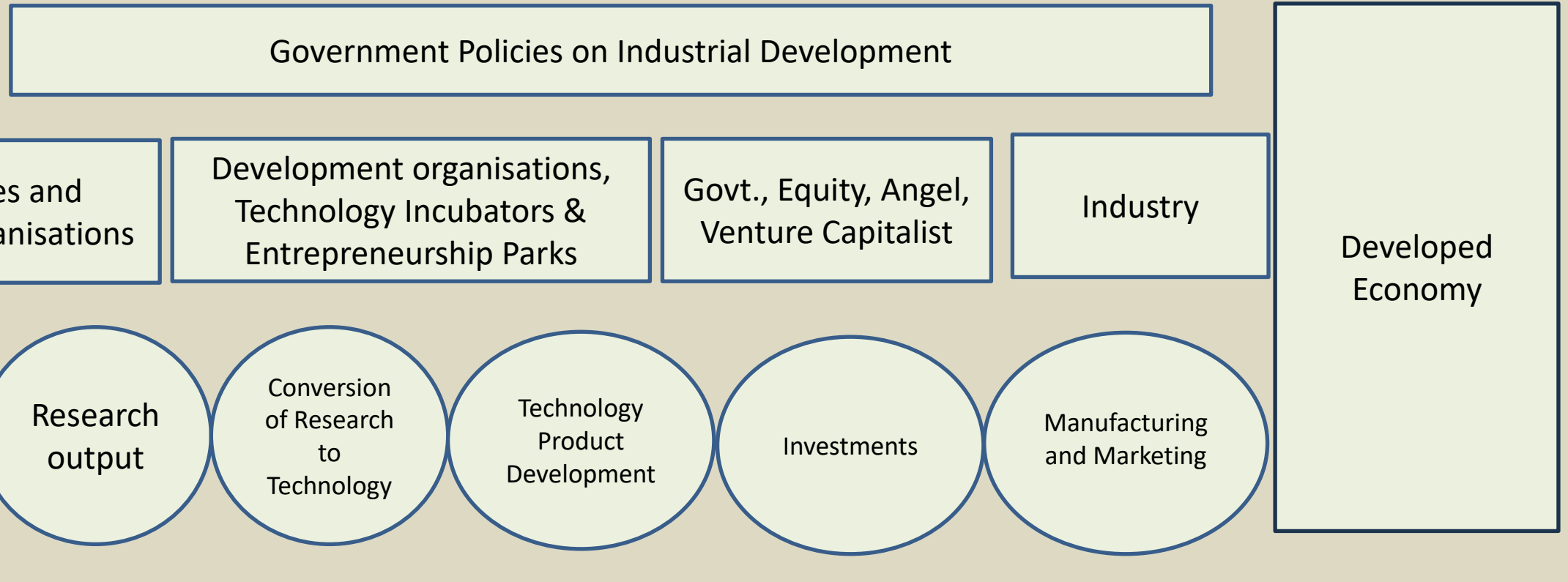
Attributes of a Good Culture

Attribute	Characteristics	Benefits
Respect for Diversity and Inclusion	Embraces differences in race, gender, religion, and opinions; promotes equity and equal opportunities	Fosters innovation and creativity; builds trust and cohesion among members
Ethical Standards and Integrity	Upholds honesty, transparency, accountability, and strong moral values	Builds credibility and trust; promotes fairness and justice
Commitment to Growth and Learning	Encourages personal and professional development; supports innovation and lifelong learning	Improves skills and adaptability; fosters resilience in changing environments
Collaboration and Teamwork	Promotes open communication, mutual respect, and cooperation over competition	Enhances problem-solving and productivity; strengthens relationships and community bonds
Empathy and Compassion	Understands and cares for the needs and feelings of others; provides support during challenges	Reduces conflict and promotes harmony; enhances mental and emotional well-being
Focus on Sustainability and Responsibility	Prioritizes sustainable practices; emphasizes responsible resource use	Ensures long-term prosperity and environmental health; promotes intergenerational equity
Shared Vision and Purpose	Aligns goals with collective aspirations; fosters a sense of belonging and shared responsibility	Increases motivation and alignment; drives collective success
Positive Reinforcement and Recognition	Celebrates achievements; provides constructive feedback and rewards effort	Boosts morale and motivation; encourages continuous improvement
Freedom and Flexibility	Respects individuality and autonomy; allows self-expression and choice	Fosters creativity and innovation; builds a sense of ownership and accountability
Resilience and Adaptability	Embraces change; learns from failures and challenges to grow stronger	Ensures long-term survival and relevance; encourages optimism and progress

Developed Economy



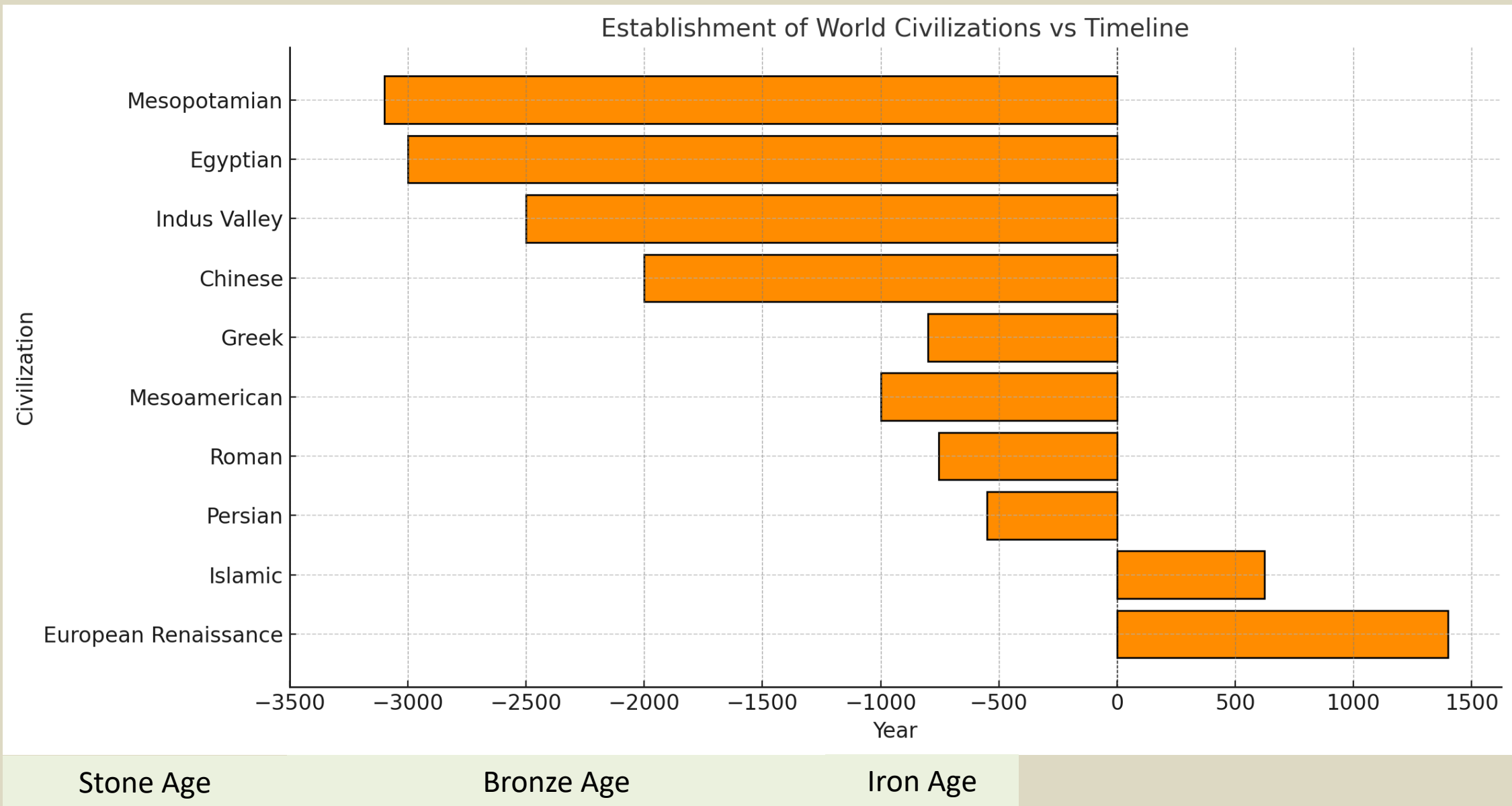
Developed Society constantly innovates and keeps developing newer technologies and newer products for its citizens to experience



A developed society with a good culture supports Maslow's hierarchy of needs, ensuring basic physiological and safety needs are met. A strong economy fosters esteem and self-actualization by offering opportunities for growth, while cultural values promote inclusivity, ethics, and collaboration, helping individuals thrive and reach their full potential.

Brief History of World

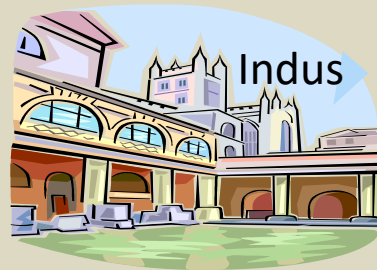
Civilizations



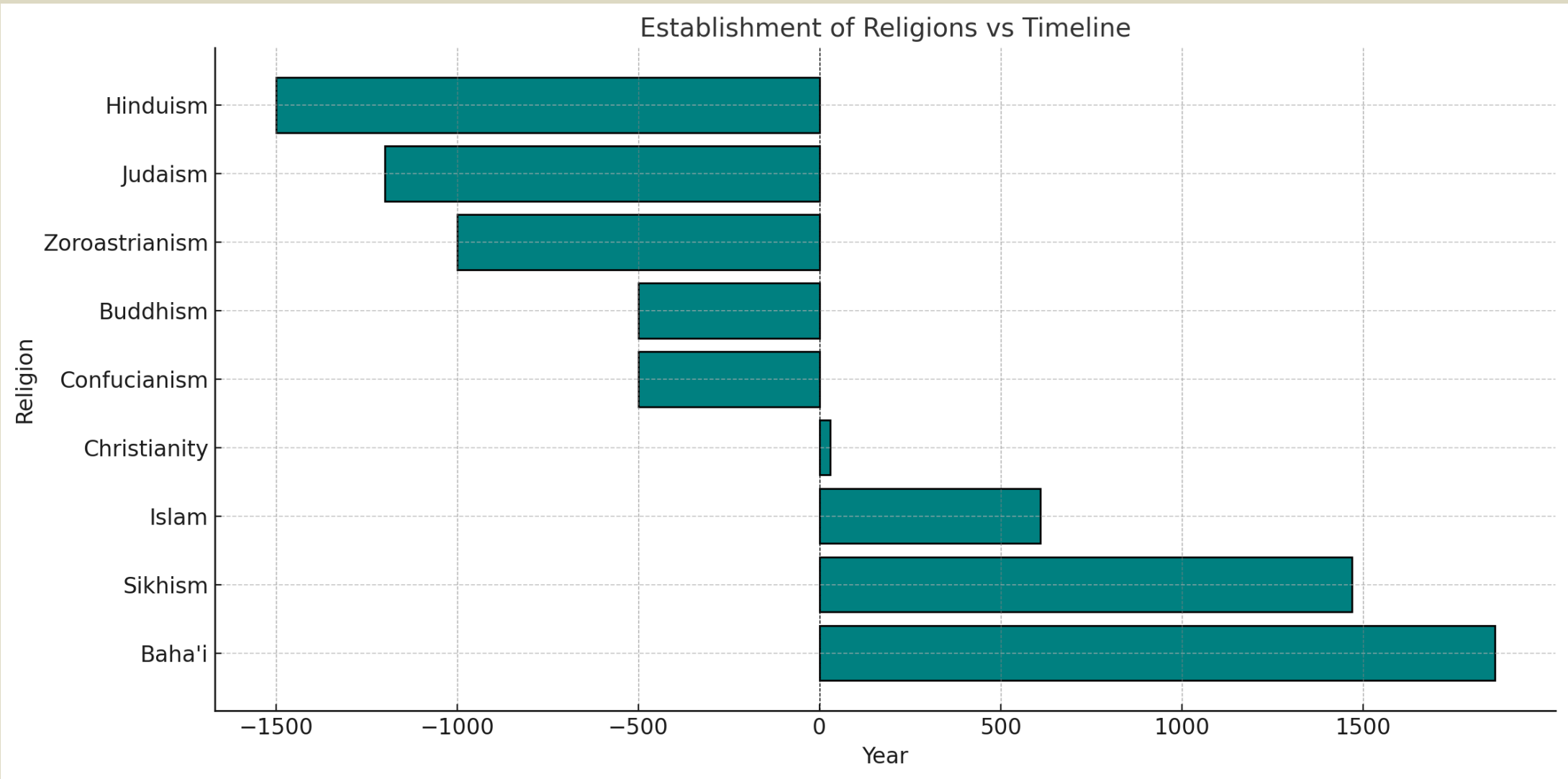
Civilizations

The Chinese made many first-known discoveries and developments. Major technological contributions from China include early seismological detectors, matches, paper, the double-action piston pump, cast iron, the iron plough, the wheelbarrow, the suspension bridge, the parachute, natural gas as fuel, the magnetic compass, the raised-relief map, the propeller, the crossbow, and gun powder.

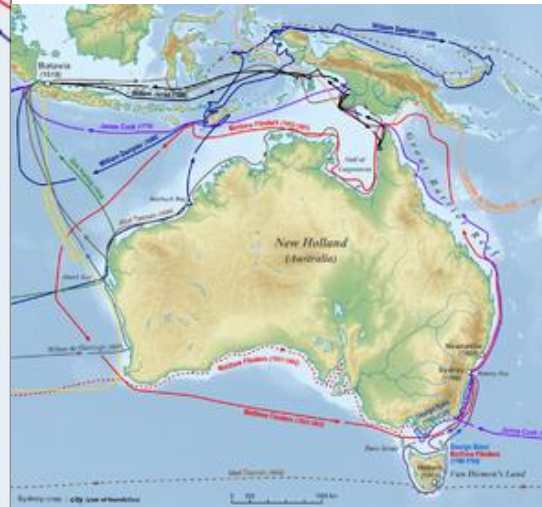
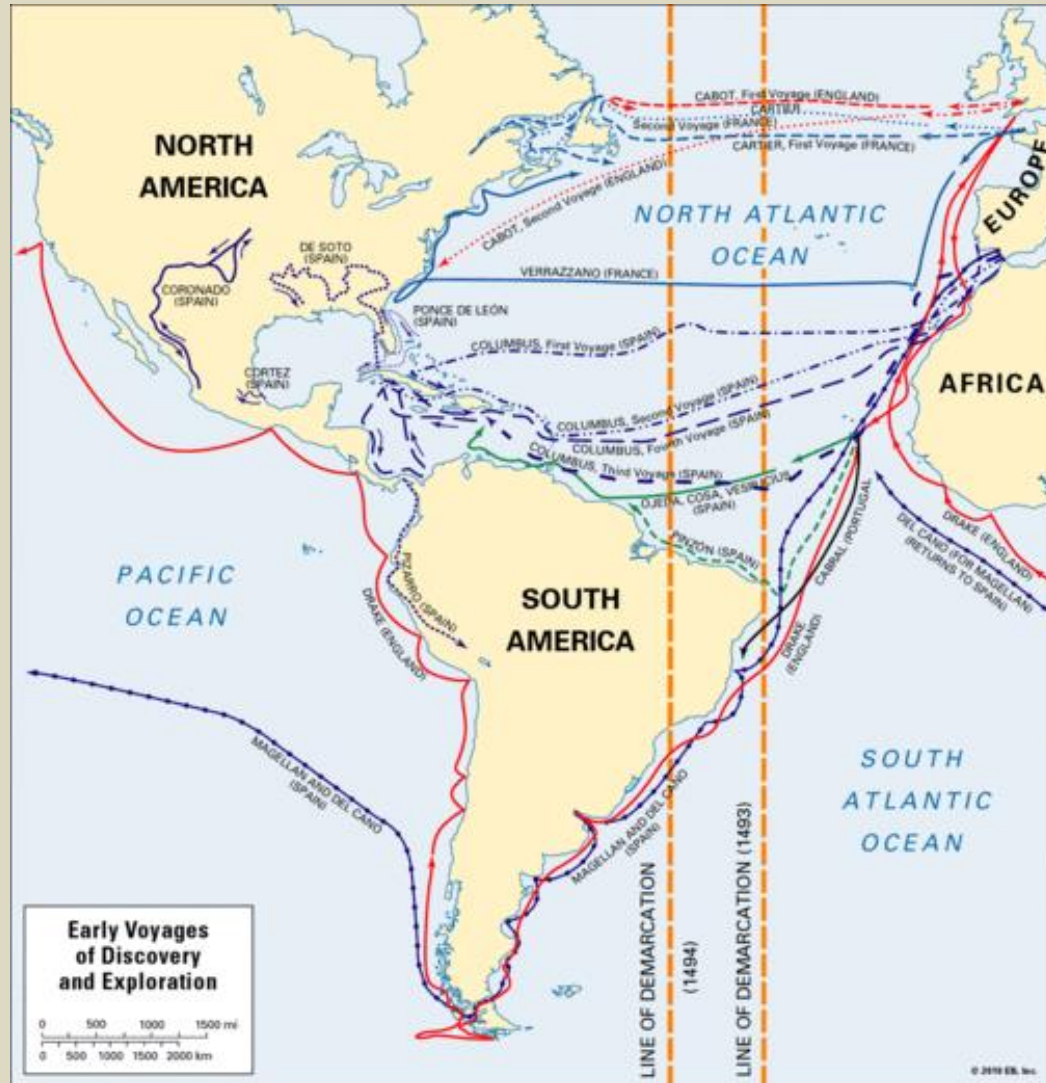
Heron of Alexandria invented a basic steam engine, watermill and windmill. Archimedes invented several machines. One example is the Archimedean screw. Other technologies invented by Greek scientists include the ballistae, and primitive analog computers like the Antikythera mechanism and the piston pump.



Religions



Voyages and Explorations



WARS

Ancient and Medieval Wars

1. **Trojan War** (c. 12th–11th century BCE)
 - Legendary conflict depicted in Greek mythology, with cultural and literary significance.
2. **Persian Wars** (499–449 BCE)
 - Greek city-states vs. Persian Empire, shaping the future of Western civilization.
3. **Peloponnesian War** (431–404 BCE)
 - A war between Athens and Sparta that weakened Greek city-states.
4. **Alexander the Great's Campaigns** (336–323 BCE)
 - Spread of Hellenistic culture across three continents.
5. **Punic Wars** (264–146 BCE)
 - Rome vs. Carthage; led to Rome's dominance in the Mediterranean.
6. **Crusades** (1096–1291 CE)
 - Religious wars between Christians and Muslims, shaping medieval Europe and the Middle East.
7. **Hundred Years' War** (1337–1453)
 - England vs. France; significant in the development of national identities.

Early Modern Wars

8. **Ottoman Wars** (14th–20th century)
 - A series of conflicts that expanded the Ottoman Empire, affecting Europe, Asia, and Africa.
9. **Thirty Years' War** (1618–1648)
 - A devastating European conflict that influenced the balance of power.
10. **American Revolutionary War** (1775–1783)
 - Secured U.S. independence and inspired democratic movements.
11. **Napoleonic Wars** (1803–1815)
 - Redefined European borders and political ideologies.

WARS

Modern Wars

12. American Civil War (1861–1865)

- Ended slavery and reshaped the United States.

13. World War I (1914–1918)

- The first global war, leading to massive loss of life and political upheaval.

14. World War II (1939–1945)

- A global conflict that reshaped geopolitics and spurred advancements in technology.

15. Korean War (1950–1953)

- Cemented Cold War divisions in East Asia.

16. Vietnam War (1955–1975)

- Significant for its impact on global Cold War dynamics and cultural shifts.

Contemporary Wars

17. Gulf War (1990–1991)

- Highlighted the role of modern warfare technology and the influence of oil politics.

18. War on Terror (2001–present)

- Global anti-terrorism efforts following the 9/11 attacks.

19. Syrian Civil War (2011–present)

- Ongoing conflict with widespread humanitarian and geopolitical consequences.

20. Ukraine War (2014–present, with escalation in 2022)

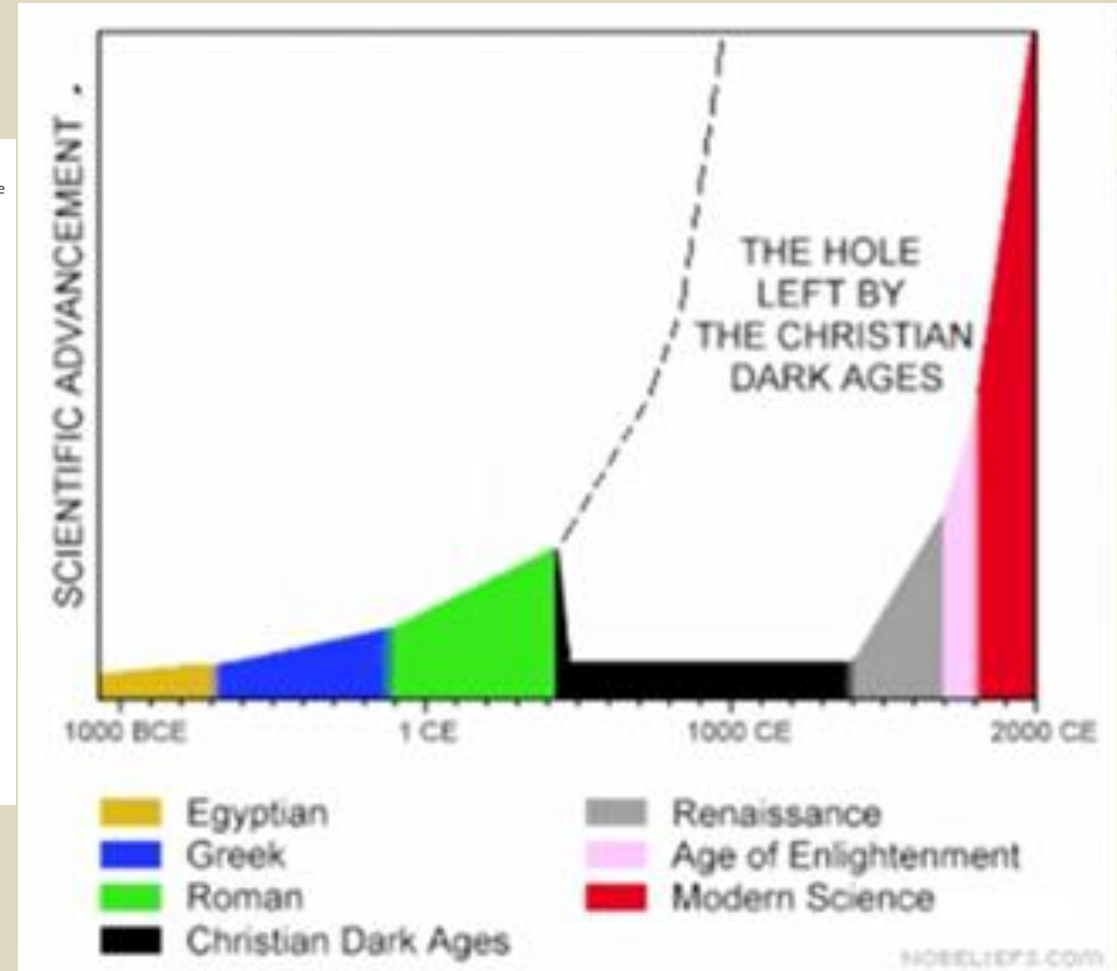
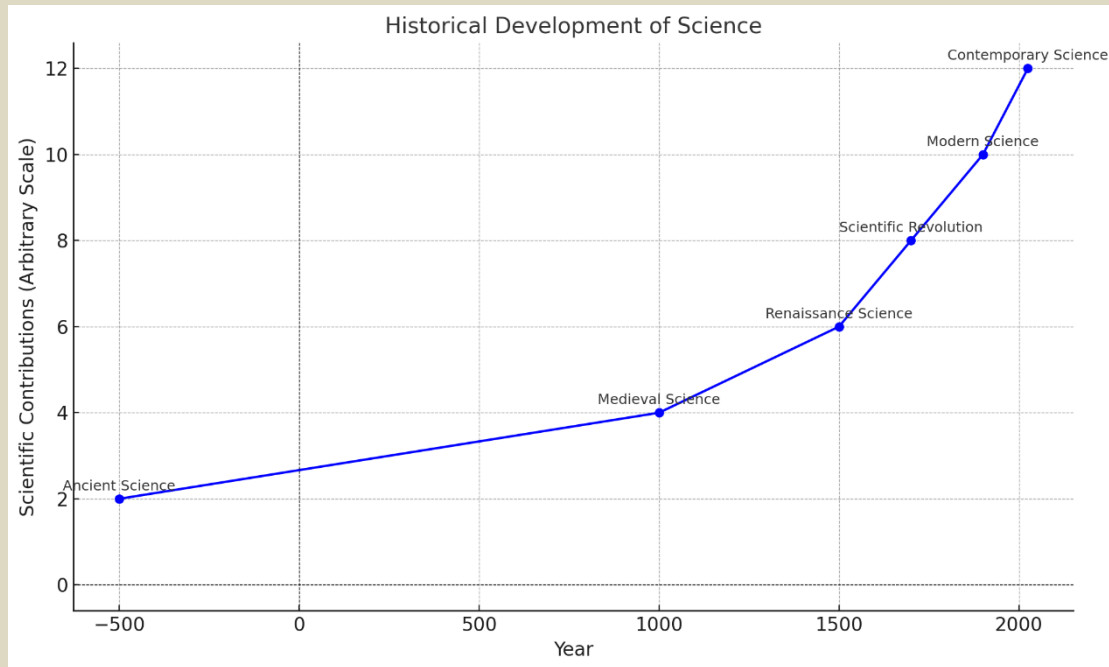
- Ongoing war significantly affecting global energy, food supplies, and security dynamics.

Except Greenland, all the countries have involved in the war one or the other time

WARS

These wars not only redefined territorial boundaries but also transformed economies, societies, and technologies, leading to both destruction and innovation. Key outcomes include the evolution of governance systems, international cooperation (e.g., the UN), and shifts in global power dynamics.

Development of Science



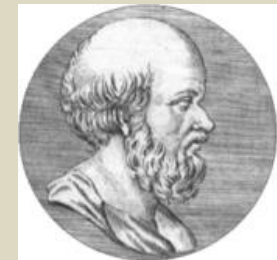
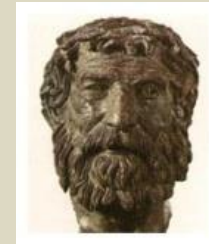
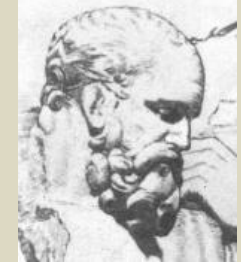
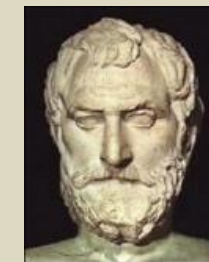
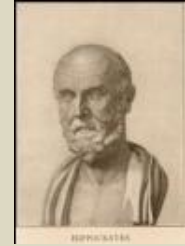
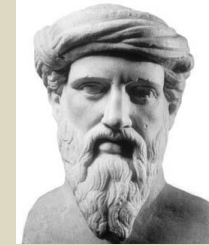
Development of Science (3000 BC-500 CE)

Pythagoras started a Mathematics School
Chemistry consisted Five basic elements
Hippocrates and Galen-Anatomy and Medicine

Eudoxus of Cnidus, Aristotle of Stagira, Euclid of Megara,
Archimedes of Syracuse, Apollonius of Perga, Ptolemaeus

Mathematics was born in Egypt
Pre-Socratic Philosophers Develop Systematic Science
Thales of Miletus –The Father of Science

Thales of Miletus (c. 620 BCE – c. 546 BCE)-Greek: non-Supernatural explanations for earth quakes, lightening. Predict Solar eclipse, drought etc. Anaximander-Life came from water and mud, Empedocles-discovered air, Democritus-matter made up of atoms, Eratosthenes-measured the size of earth



Development of Science (500 CE-1300 CE)

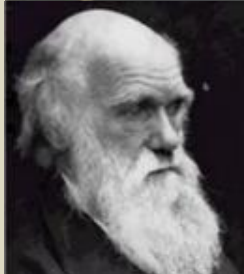
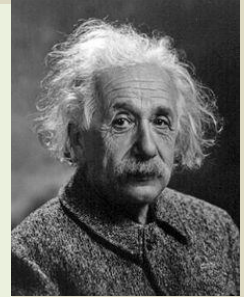
Science started Progressing in Roman Empire; Most of the Development in Science was in Islamic World in this period, Christian Dark Ages

Development of Science (1400CE-1700 CE)

Renaissance- Age of Enlightenment



Isaac Newton-Newtonian Mechanics; Alchemy - became popular, Priestly, Lavoisier;
Darwin's Theory of Evolution, Mendel's Theory of Genetics; Einstein's -Theory of Relativity



The Scientific Revolution: Copernicus-Heliocentric Theory Against Ptolemaic Geocentric theory; The bible is a book about how to go to heaven , it is not a book about how the heavens go



St. Thomas Aquinas-Knowing God by Studying His creation: Encouraged Free Thinking, Thinkers turned away from Church

Francis –Bacon-Scientific Method: Analysis, Modelling, Deductive Reasoning, Experimentation: Boyle's Law, Laws of Electricity, Harvey's theory of circulation,; Telescope, Microscope, compass, printing press, gunpowder

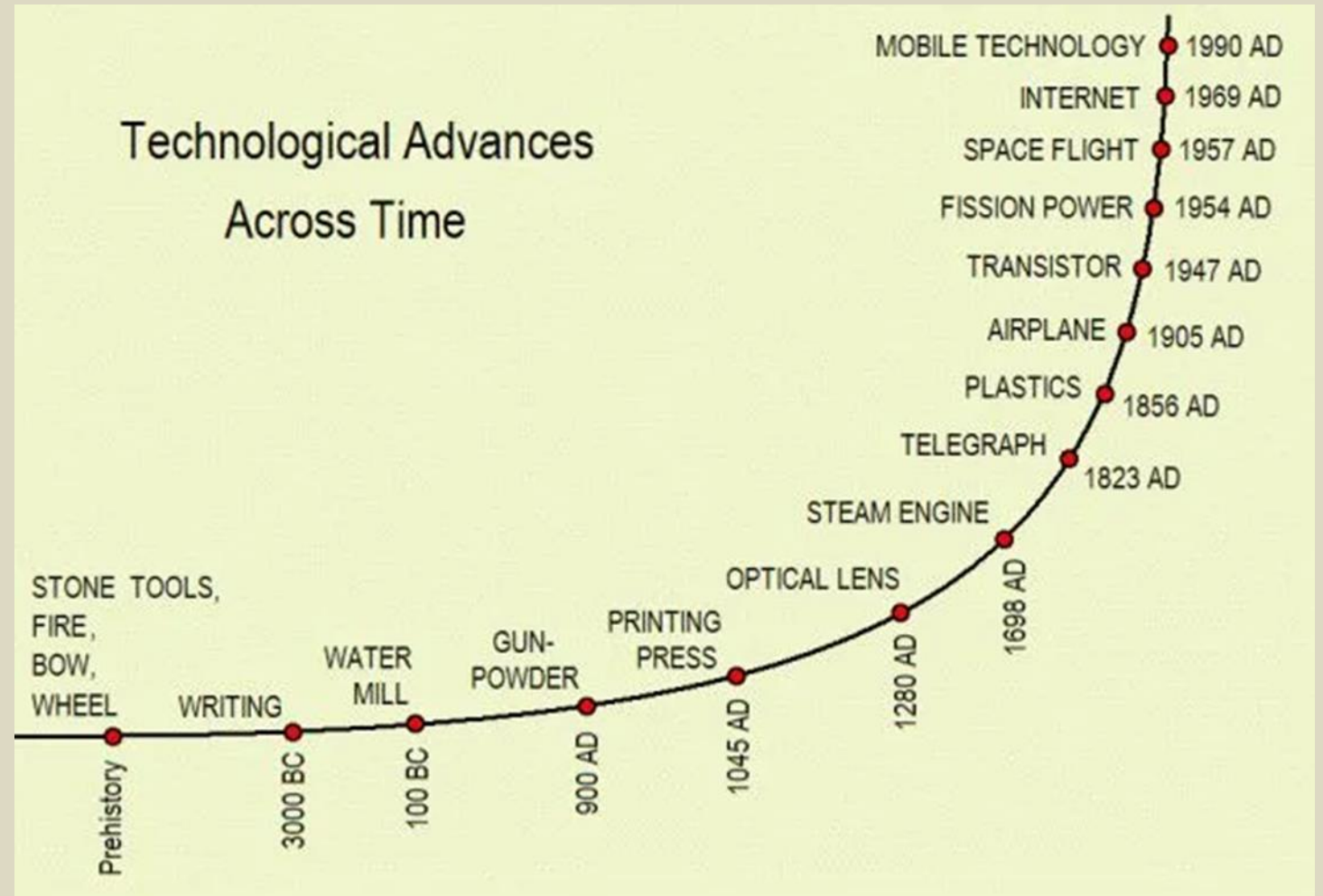


Technological Inventions

The invention of tools and techniques is evidence of a society's ability to solve problems that were encountered in every day life.

Technological artifacts are products of a society's economy, a force for economic growth, and a large part of everyday life

Technological innovations affect, and are affected by, a society's cultural traditions



The Bad Part-Deterioration of Nature

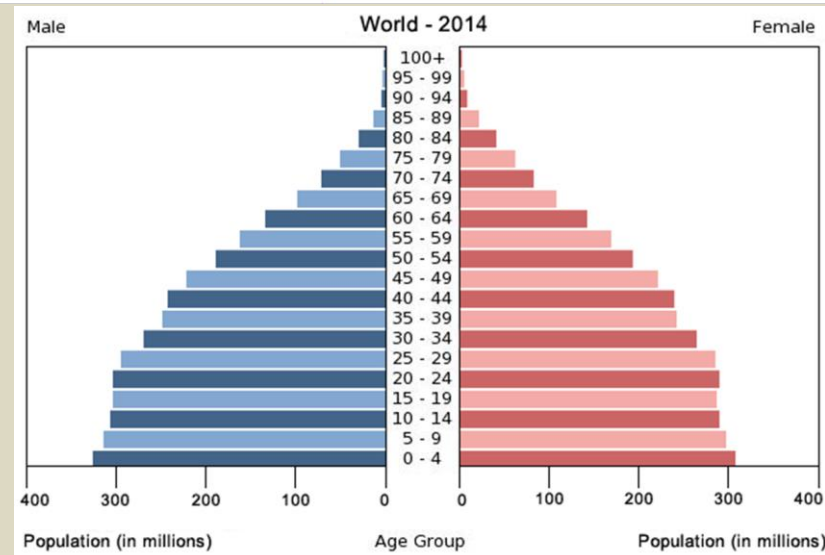
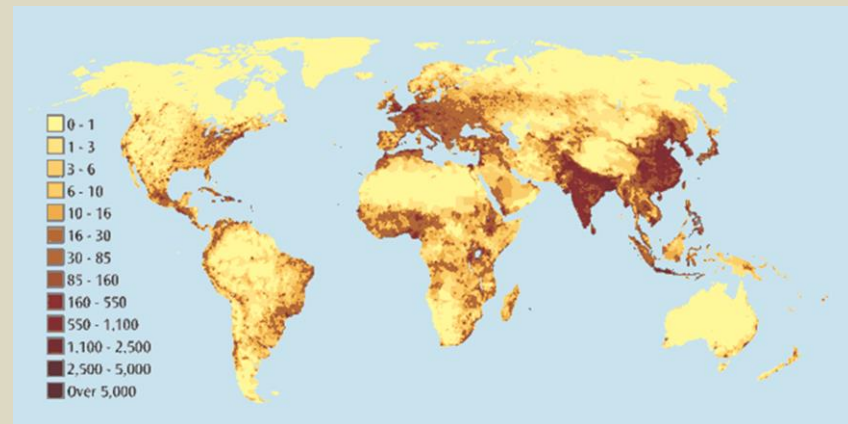
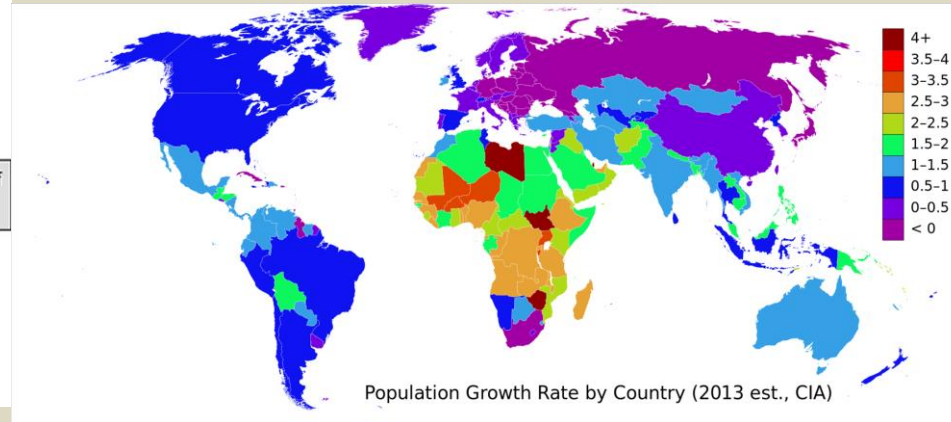
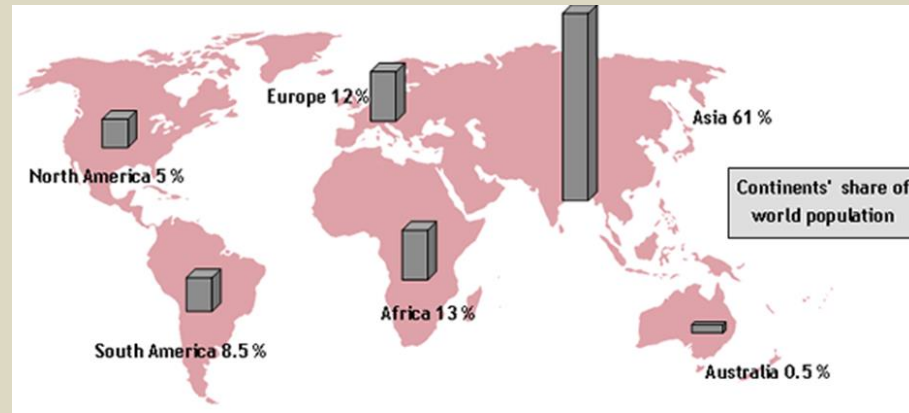


The World At Present

Global Population

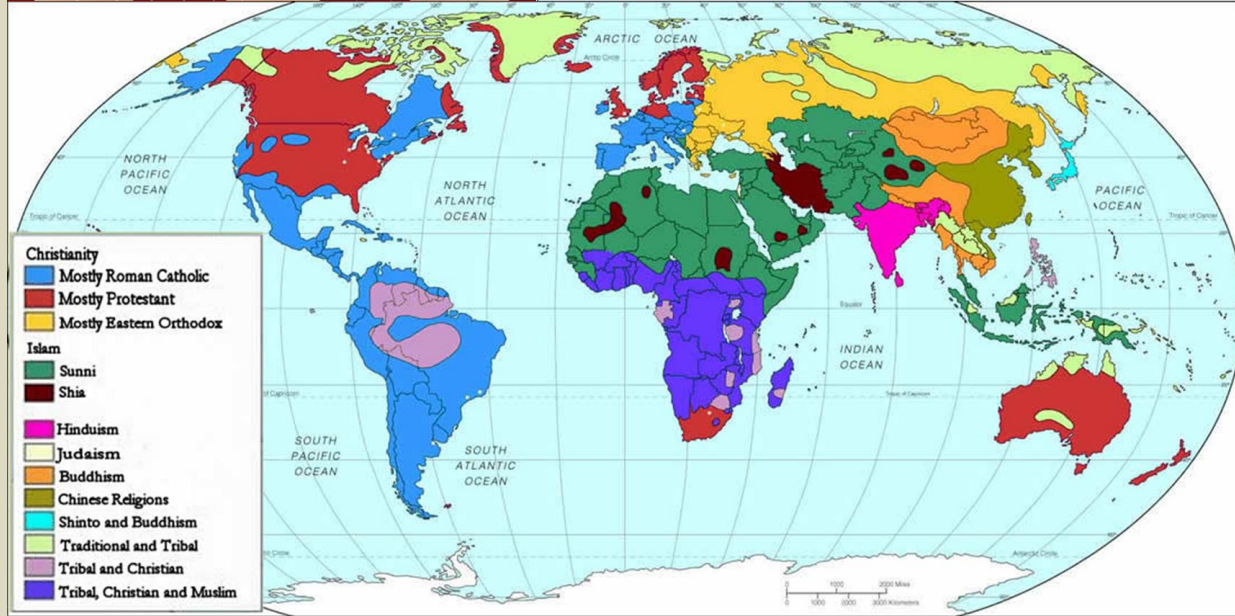
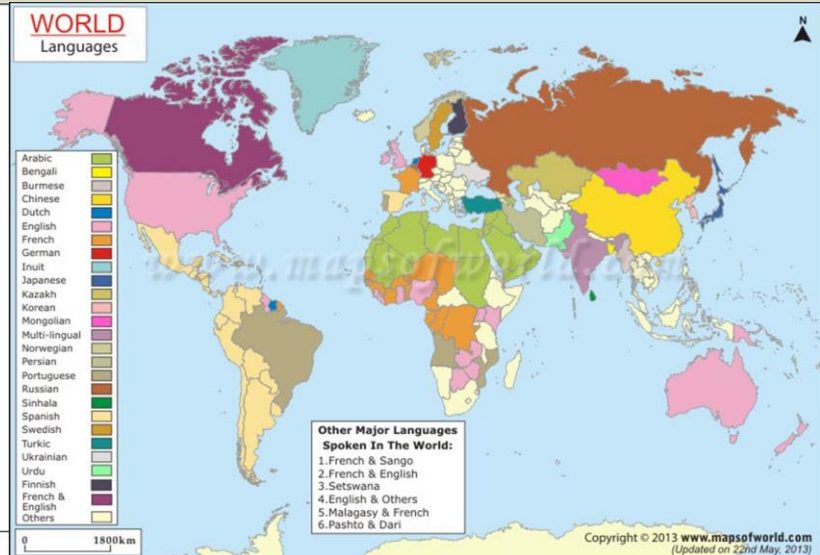
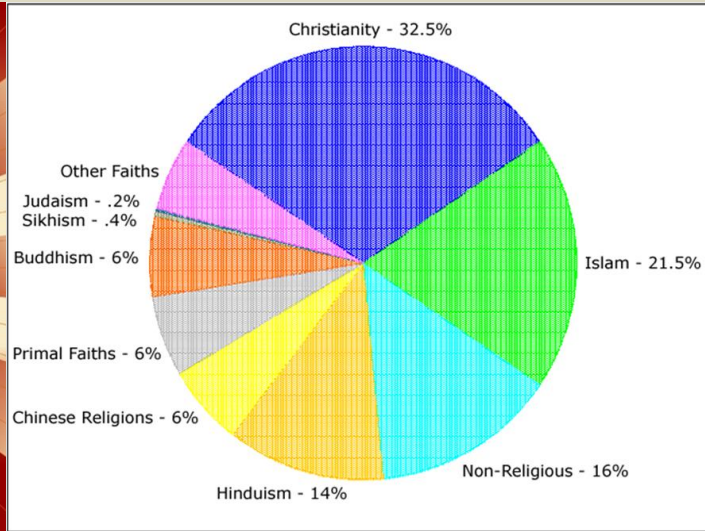
2015: 7.32 Billion

Year	1	1000	1500	1650	1750	1804	1850	1900	1927	1950	1960	1974	1980	1987	1999	2011	2020	2024	2030	2040	2050	2062	2100
Pop, (billions)	0.2	0.275	0.45	0.5	0.7	1	1.2	1.6	2	2.55	3	4	4.5	5	6	7	7.7	8	8.4	9	9.5	10	10.8



Demographics

Global Religions and Cultures



- Chinese (Mandarin) is the most spoken language of the World. Some of the other major languages which are widely spoken are Spanish, English, Bengali, Hindi/Urdu, Arabic, Portuguese, Russian, Japanese, German and French.

- There are more than 2,700 languages in the world.

Economic Status of the World

As of 2024, the global economic landscape is characterized by the following key indicators:

- **World GDP:** Approximately **\$115.49 trillion**. [IMF](#)
- **GDP Growth Rate:** Projected at **2.8%** for 2024 and expected to remain at the same rate in 2025. [Reuters](#)
- **GDP Per Capita:** Estimated at around **\$14,500**, based on the global population and GDP figures.
- **Unemployment Rate:** Global unemployment is projected to remain steady, with little positive change expected in 2024. [UNSD](#)
- **Population Below Poverty Line:**
 - **Extreme Poverty:** Approximately **692 million people** (about 8.5% of the global population) live on less than \$2.15 per day. [World Bank Blogs](#)
 - **Multidimensional Poverty:** Around **1.1 billion people** experience acute multidimensional poverty, facing deprivations in health, education, and living standards. [Human Development Reports](#)

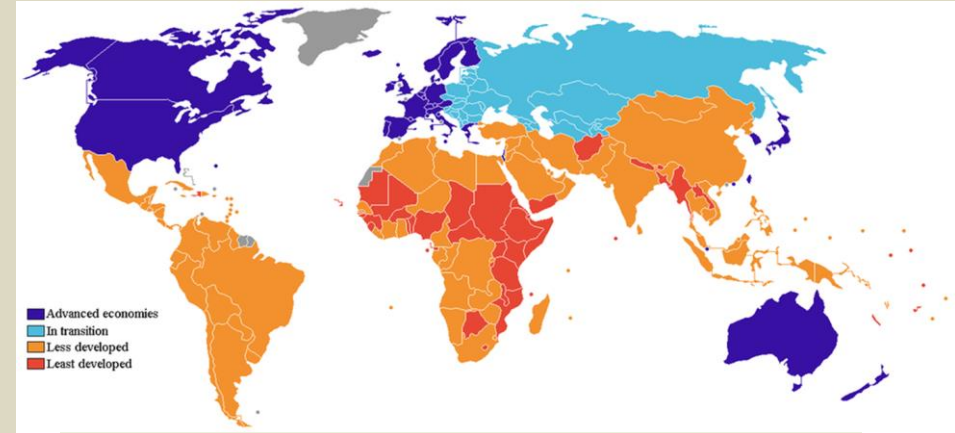
These figures highlight ongoing challenges in addressing unemployment and poverty worldwide, despite overall economic growth.

Economic Status of the World

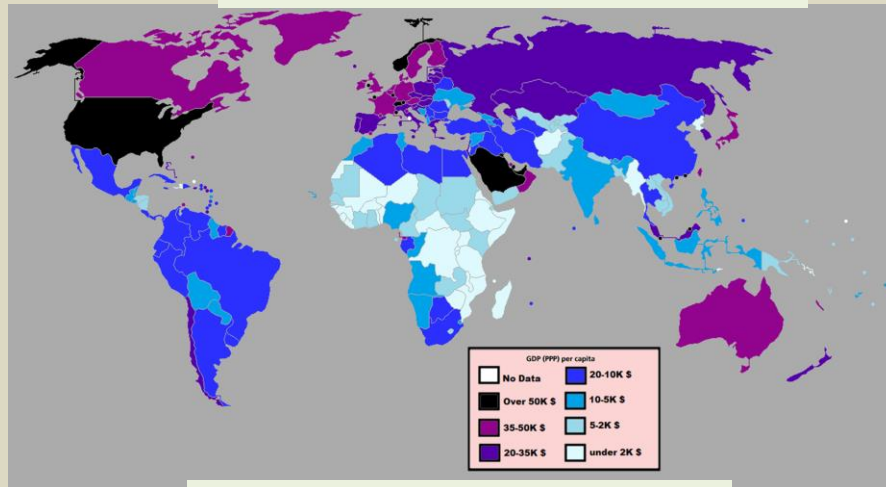


Africa	54
Asia	44
Oceania (Australia)	14
Europe	47
North America	23
South America	12
Antartica	00
Total	194 (some sources indicate 195)

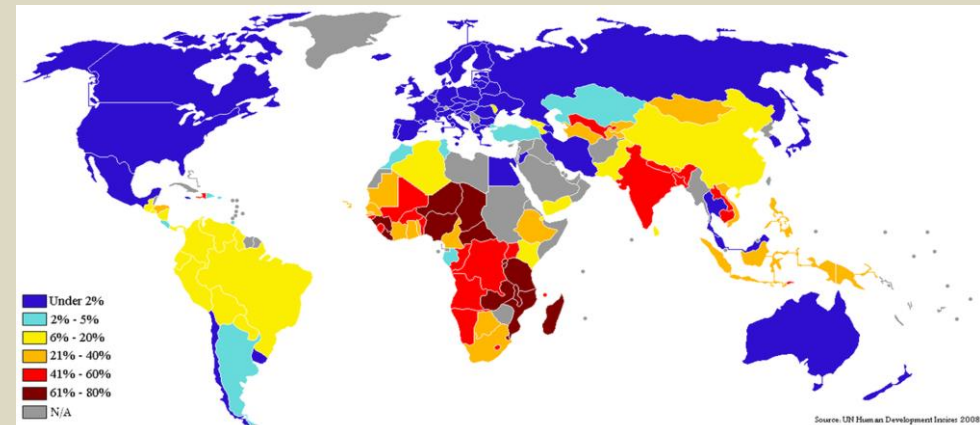
Number of Countries



Developed and Developing Countries

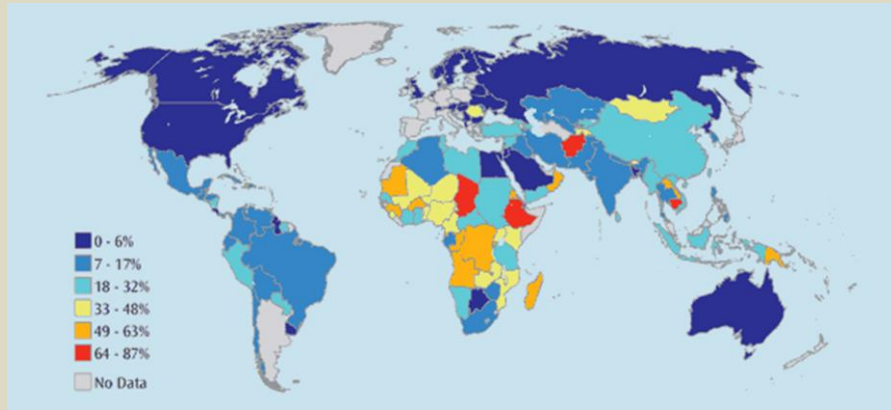


Per Capita Income



World population living on less than \$1.25 per day

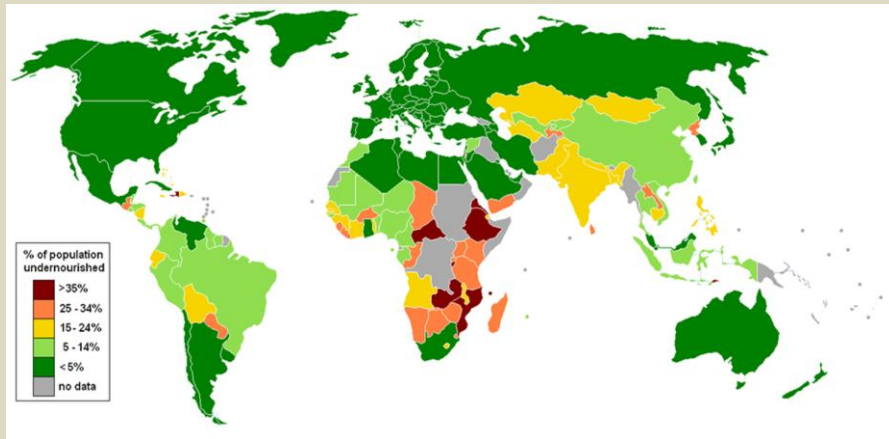
Access to Basic Facilities in the World



No Access to Safe Drinking Water

	Without access to electricity	
	Population	Share of population
Developing countries	1 265	24%
Africa	590	57%
DR of Congo	58	85%
Ethiopia	65	77%
Kenya	33	82%
Nigeria	79	50%
Tanzania	38	85%
Uganda	29	92%
Other sub-Saharan Africa	286	66%
North Africa	1	1%
Developing Asia	628	18%
Bangladesh	88	54%
China	4	0%
India	293	25%
Indonesia	63	27%
Pakistan	56	33%
Philippines	16	17%
Vietnam	2	2%
Rest of developing Asia	106	34%
Latin America	29	6%
Middle East	18	9%
World**	1 267	19%

Population in Million

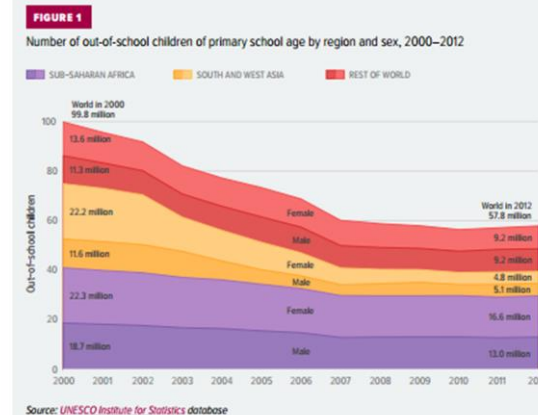
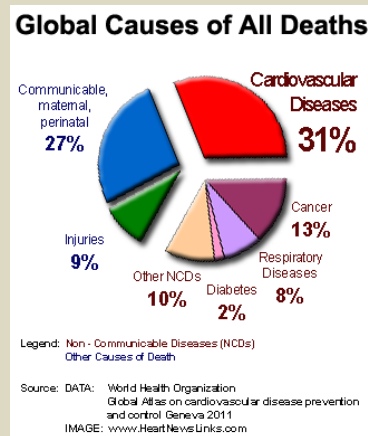
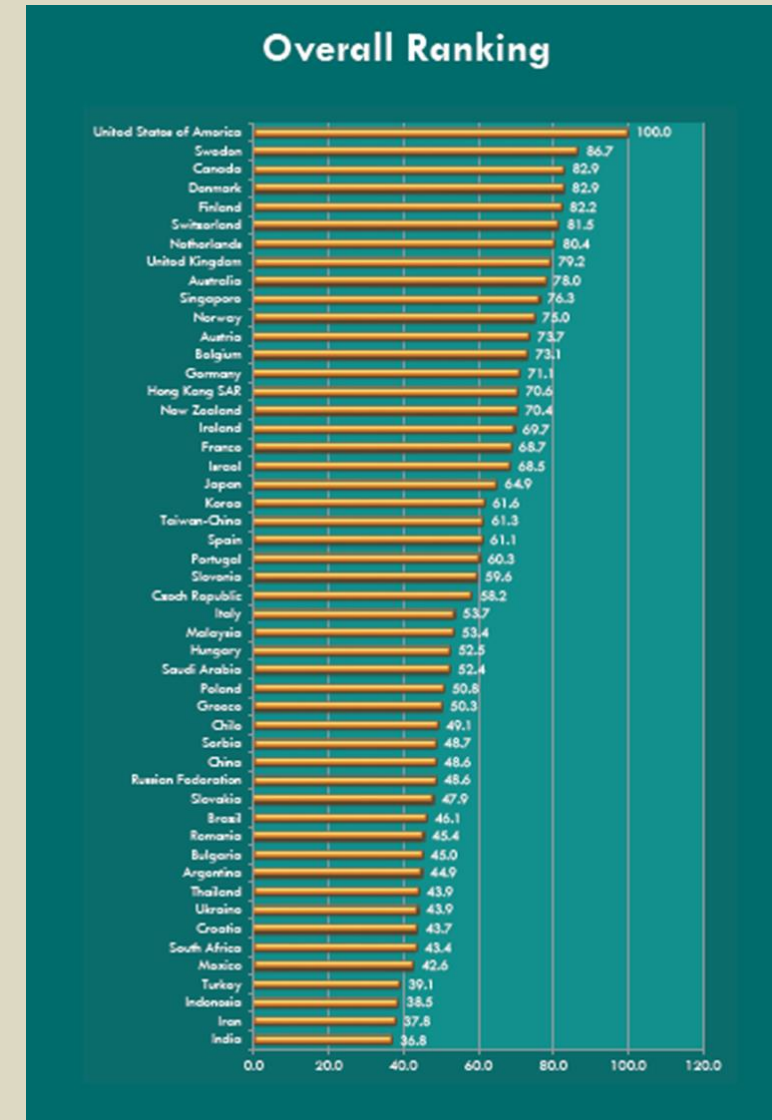
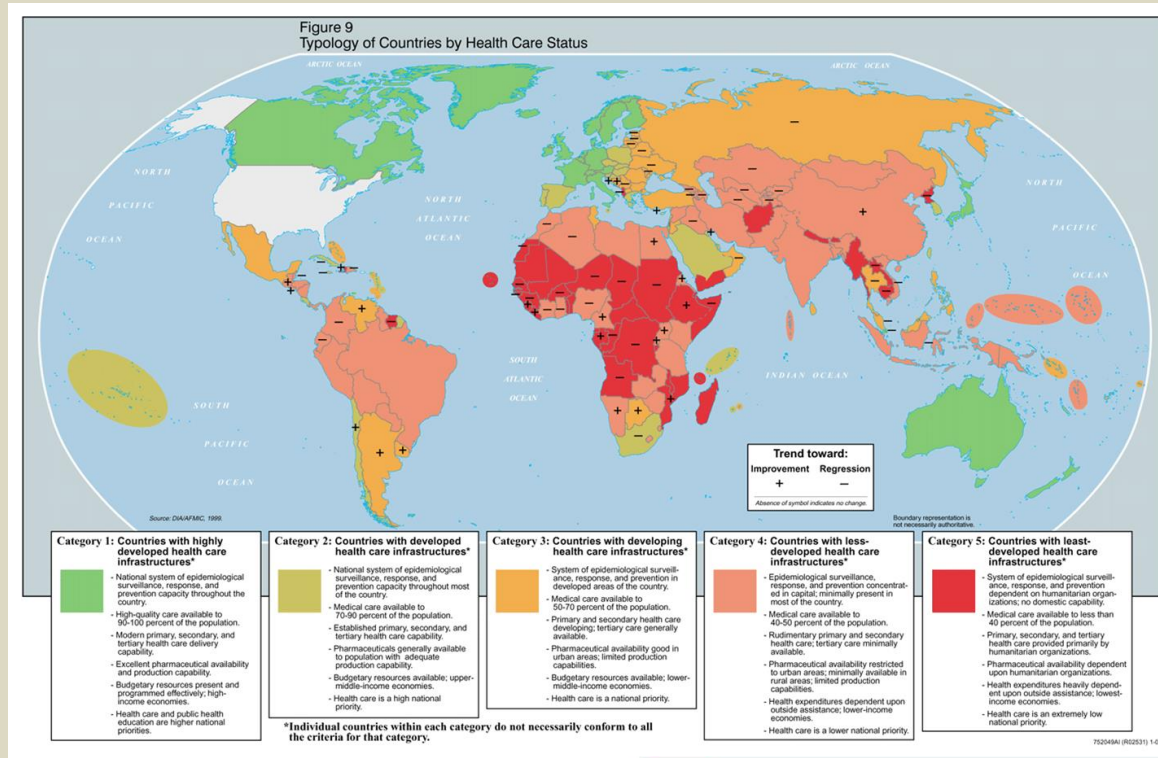


Suffering from Hunger

No Shelter

The 2005 U.N. report looked only at people who did not have any homes whatsoever. Not included were people who lived in terrible semi-permanent places such as abandoned buildings, vehicles, hastily put together shelters or tents. The report also did not include the “hidden homeless,” who bounce from shelter to shelter or from friend’s house to friend’s house. Countries such as England include the hidden homeless as legally homeless. No one really knows just how many people do not have any permanent place to call their own. It is estimated that there could be as many as another 100 million hidden homeless in the world, bringing the conservative estimate of the total population of homeless to 200 million.

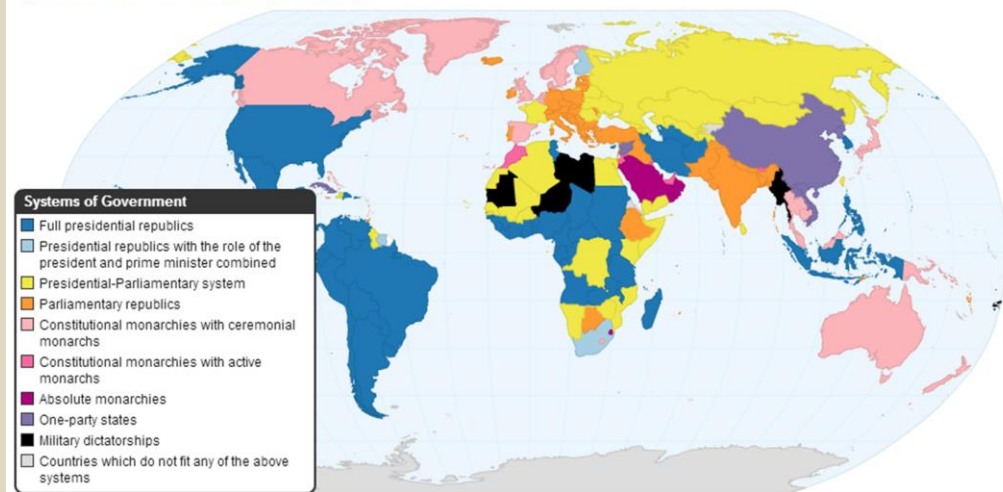
Access to Basic Facilities in the World



Access to Primary Education

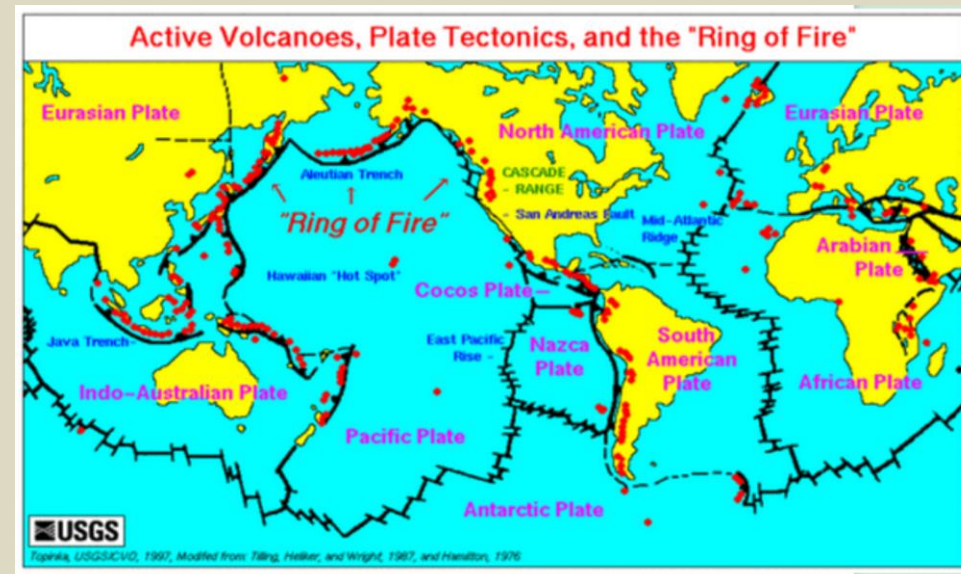
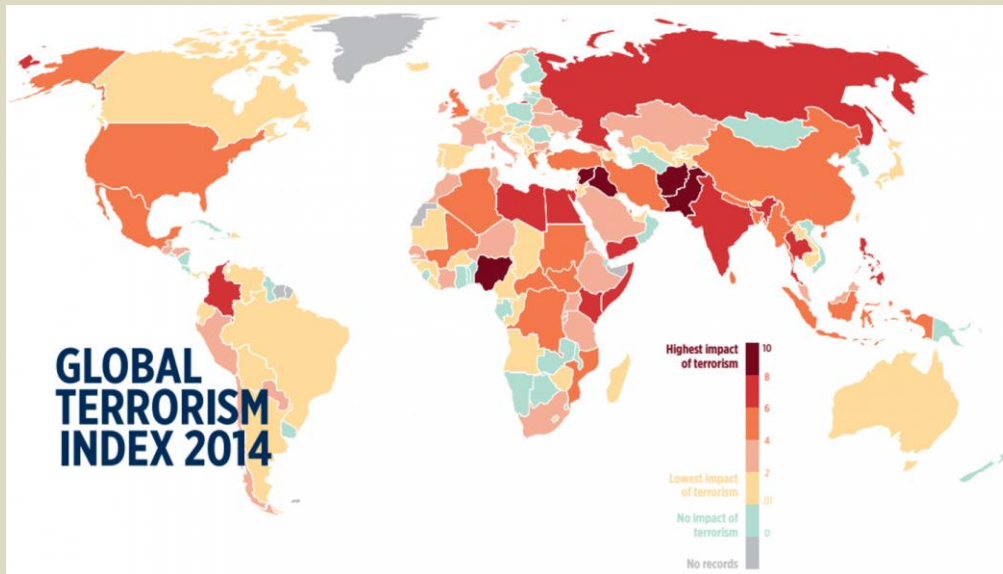
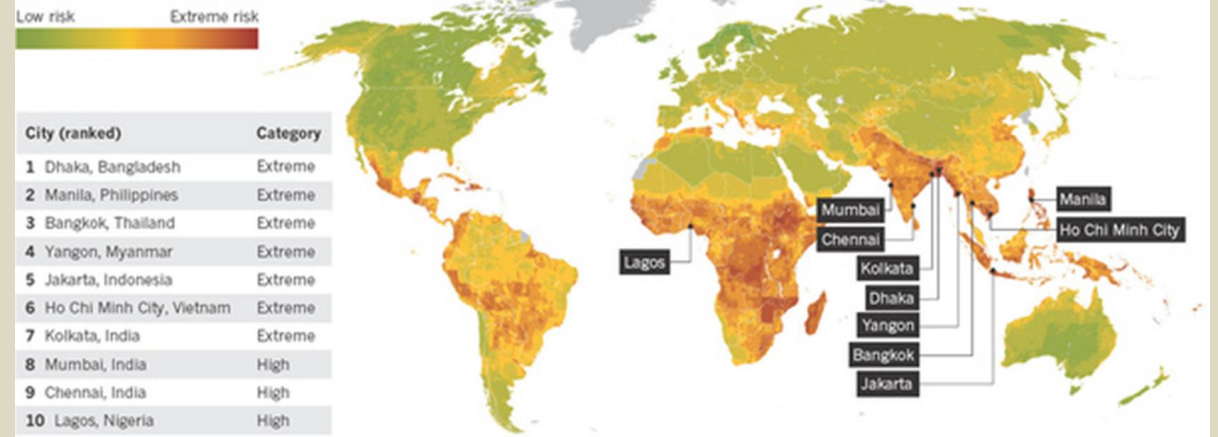
Countries –Stability, Danger and Under Threat

Systems of Government by Country

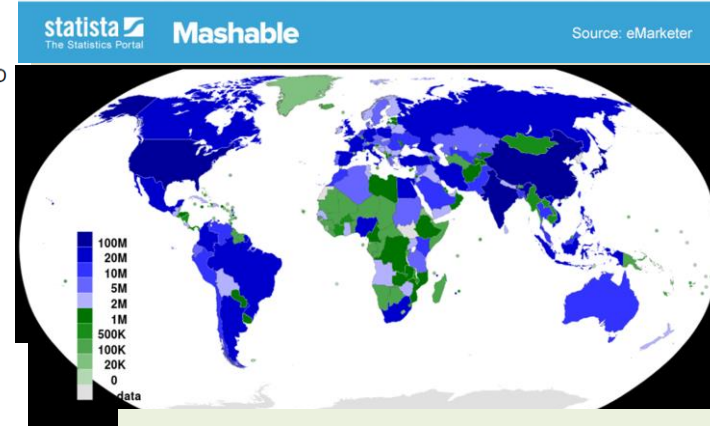
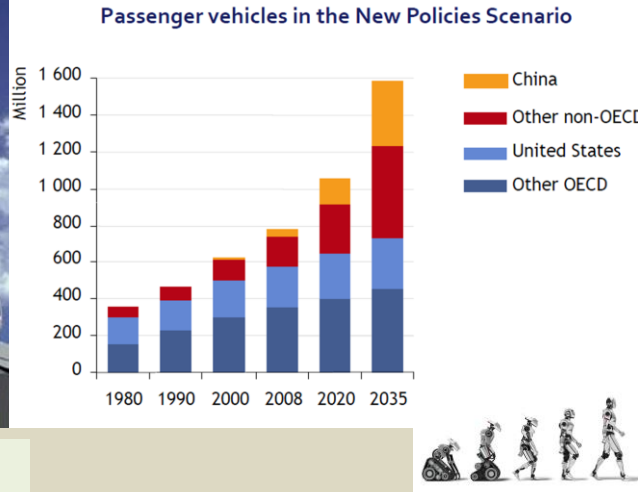
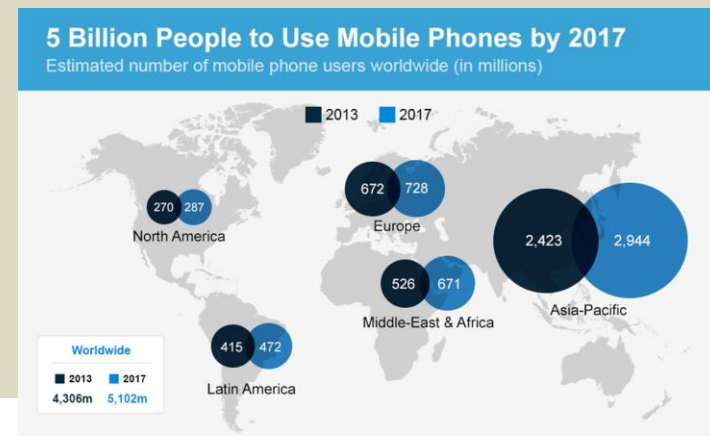
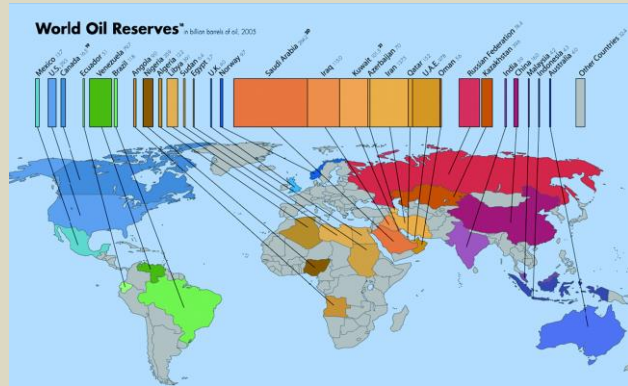


DANGER DEPICTED

Risk analysts develop visual representations of risk levels, such as this 2013 map from Maplecroft in Bath, UK, which shows the cities most vulnerable to the effects of climate-related natural disasters and rising sea levels.



Energy and Technologies



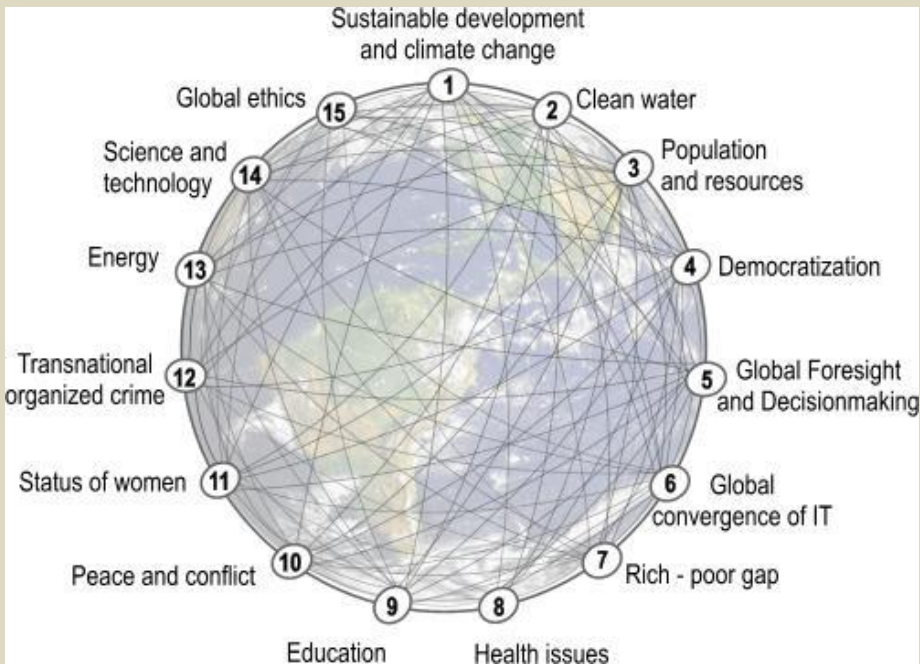
Advanced Mass Transit

Number of Internet User



Global military expenditure stands at over \$1.7 trillion in annual expenditure at current prices for 2012. It fell by around half a percent compared to 2011 — the first fall since 1998.

Global Challenges of the 21st Century



The 15 Global Challenges:

1. How can sustainable development be achieved for all while addressing global climate change?
2. How can everyone have sufficient clean water without conflict?
3. How can population growth and resources be brought into balance?
4. How can genuine democracy emerge from authoritarian regimes?
5. How can decision making be enhanced by integrating improved global foresight during unprecedented accelerating change?
6. How can the global convergence of information and communications technologies work for everyone?
7. How can ethical market economies be encouraged to help reduce the gap between rich and poor?
8. How can the threat of new and reemerging diseases and immune micro-organisms be reduced?
9. How can education make humanity more intelligent, knowledgeable, and wise enough to address its global challenges?
10. How can shared values and new security strategies reduce ethnic conflicts, terrorism, and the use of weapons of mass destruction?
11. How can the changing status of women help improve the human condition?
12. How can transnational organized crime networks be stopped from becoming more powerful and sophisticated global enterprises?
13. How can growing energy demands be met safely and efficiently?
14. How can scientific and technological breakthroughs be accelerated to improve the human condition?
15. How can ethical considerations become more routinely incorporated into global decisions?

India At Present

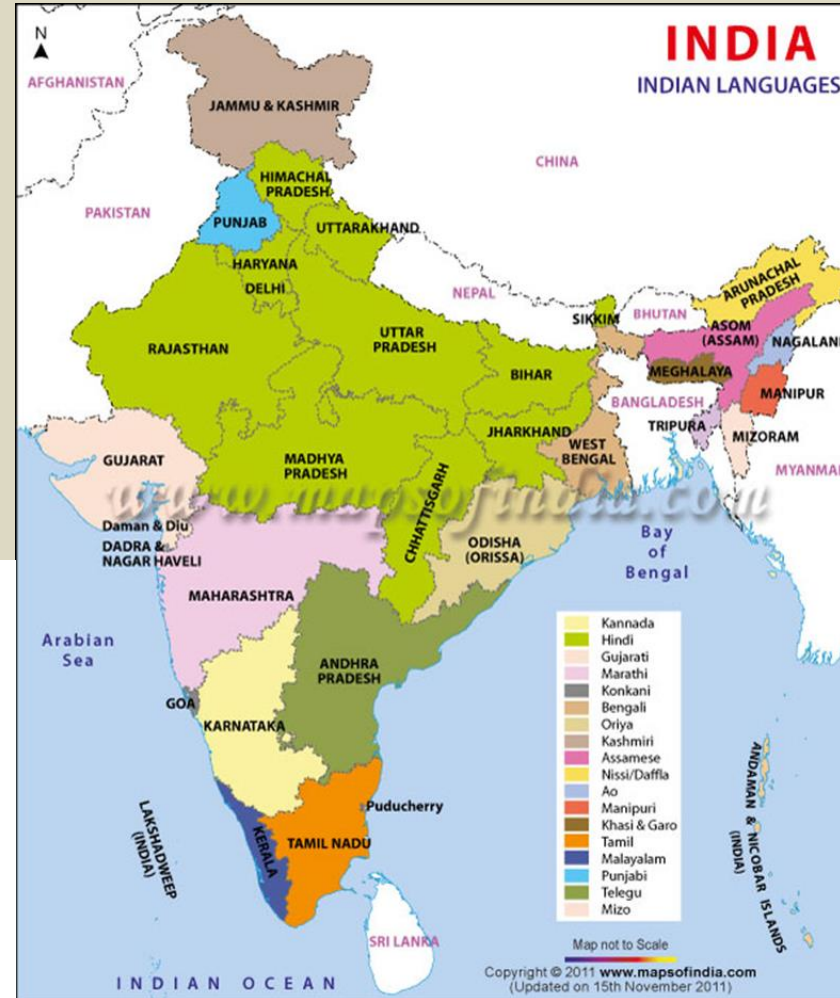
India Population

As of 2024, India's demographic and administrative details are as follows:

- Total Population in India: Approximately 1.4 billion.
- Male Population: Approximately 723 million.
- Female Population: Approximately 677 million.
- Ratio of Female to Male: Approximately 937 females per 1,000 males.
- Demography:
 - Age Structure:
 - 0-14 years: 26.16%
 - 15-64 years: 67.27%
 - 65 years and over: 6.57%
 - Population Growth Rate: 0.97% per annum.
 - Urban Population: Approximately 35% of the total population.
- Number of States: 28
- Number of Union Territories: 8

Note: These figures are based on projections and estimates, as the most recent official census data is from 2011. The next census is anticipated to provide updated statistics.

Religion and Culture



India has 122 major languages and 1599 other languages.

India has 22 Official Languages

As of 2024, India's religious composition is as follows:

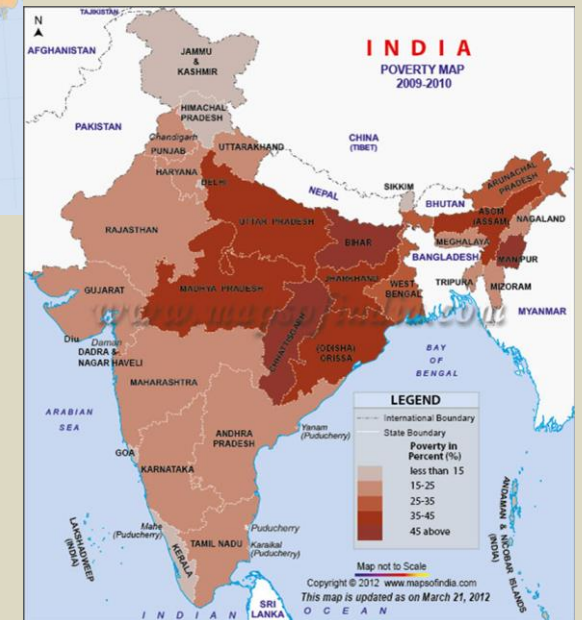
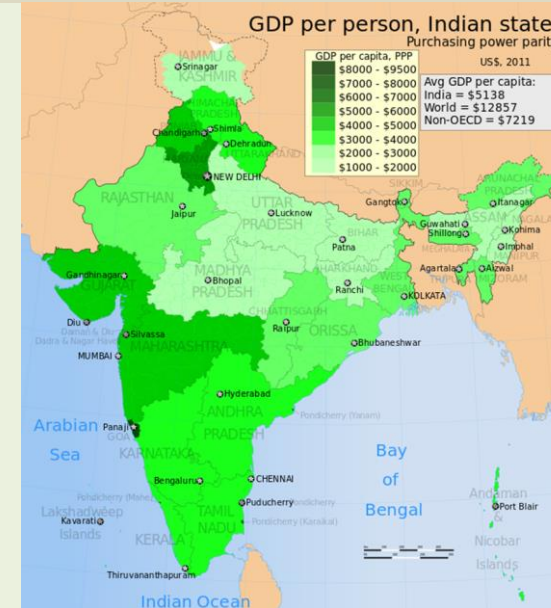
Religion	Population (in billions)	Percentage (%)
Hinduism	1.12	80.0
Islam	0.23	16.4
Christianity	0.03	2.1
Sikhism	0.02	1.4
Buddhism	0.01	0.7
Jainism	0.01	0.7
Others	0.01	0.7

Note: These figures are based on estimates and projections, as the most recent official census data is from 2011. The next census is anticipated to provide updated statistics.

Economic Status of India

As of 2024, India's economic indicators are as follows:
Population is approximately **1.441 billion**.

- **GDP:**
 - Nominal: Approximately \$4.27 trillion. [IMF](#)
 - Per capita: Around \$2,940. [IMF](#)
- **GDP by Sector:**
 - Agriculture: 13.7%
 - Industry: 21.5%
 - Services: 64.8%
- **Labor Force:**
 - Total: Approximately 523.8 million (2022). [globalEDGE](#)
 - By Occupation:
 - Agriculture: 43.96% (2021)
 - Industry: 25.34% (2021)
 - Services: 30.7% (2021)
- **Unemployment Rate:**
 - Overall: 8% as of November 2024.



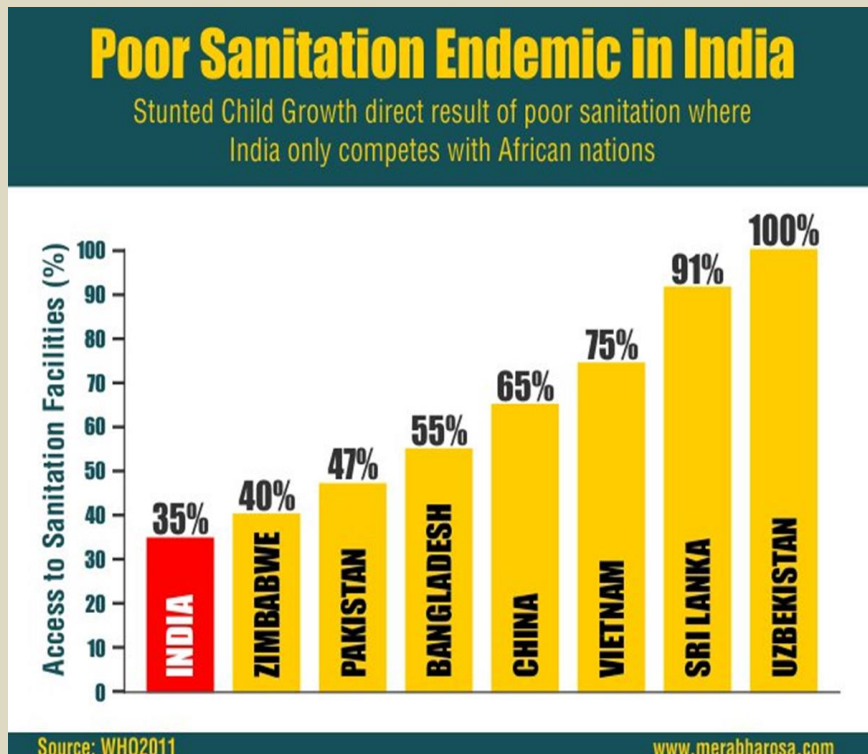
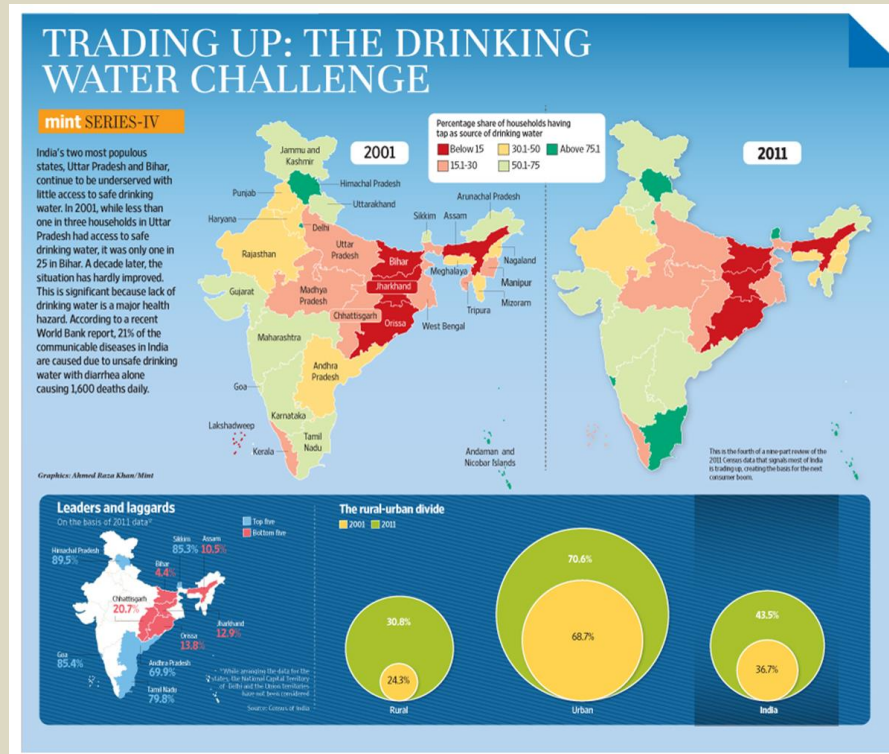
Access to Basic Facilities in India

As of 2024, the following statistics highlight the populations in India lacking access to essential services:

- **Safe Drinking Water:** Approximately 7.8% of the population, or about 78.4 million people, do not have access to safe drinking water sources. *(Source: Worldometer)*
- **Sanitation Facilities:** Around 48% of the population, or about 672 million people, lack access to improved sanitation facilities. *(Source: Water.org)*
- **Electricity Access:** Approximately 0.4% of India's population, equating to about 5.6 million people, still lack access to electricity. *(Source: Macrotrends)*
- **Shelter:** While exact data is limited, significant housing shortages exist, especially in urban informal settlements.
- **Healthcare Access:** Access to quality healthcare remains a challenge, particularly in rural areas. Approximately 20% of the population lacks access to essential health services, with rural areas facing a shortage of healthcare infrastructure and personnel. *(Source: WHO)*
- **Education:** While enrollment rates have improved, disparities persist. In 2022, 61.5% of the rural population had access to safe and adequate drinking water within their premises, which can impact school attendance and educational outcomes. *(Source: Statista)*
- These figures underscore the ongoing challenges in providing universal access to basic services in India, highlighting the need for comprehensive development policies to address these gaps.

Access to Basic Facilities in India

	Urban	Rural	Total
Improved water source	96%	84%	88%
Improved sanitation	54%	21%	31%



Access to Basic Facilities in India-Electricity

- As of September 30, 2024, India's total installed power generation capacity reached approximately **452.69 gigawatts (GW)**. [Wikipedia](#)
- **Breakdown by Energy Source:**
- **Thermal Power:** Approximately 243.06 GW (53.69% of total capacity)
 - Coal: 211.03 GW
 - Lignite: 6.62 GW
 - Gas: 24.82 GW
 - Diesel: 0.59 GW
- **Renewable Energy Sources (RES):** Approximately 154.53 GW (34.13% of total capacity)
 - Solar Power: 90.76 GW
 - Wind Power: 47.36 GW
 - Biomass/Cogeneration: 10.72 GW
 - Small Hydro Projects (SHP): 5.08 GW
 - Waste-to-Energy: 0.60 GW
- **Hydroelectric Power (Large Hydro):** Approximately 46.93 GW (10.37% of total capacity)
- **Nuclear Power:** Approximately 8.18 GW (1.81% of total capacity)
- **Sector-Wise Distribution:**
- **Central Sector:** Approximately 104.45 GW
- **State Sector:** Approximately 108.28 GW
- **Private Sector:** Approximately 239.96 GW

Healthcare

As of 2024, India's healthcare sector has experienced significant growth and transformation, reflecting the nation's commitment to improving healthcare access and quality for its population.

Healthcare Market Size:

- The Indian healthcare industry reached over **\$370 billion** in 2022 and is projected to exceed **\$610 billion** by 2026. [Trade.gov](#)

Government Healthcare Initiatives:

- In September 2024, the Indian government expanded its healthcare program to provide citizens aged 70 and above with annual medical insurance coverage of **500,000 rupees (\$6,000)** per family, benefiting an additional 60 million people. [Reuters](#)

Healthcare Expenditure:

- In the fiscal year 2023-24, India's total health expenditure is expected to reach **₹79,221 crore**, up from ₹72,269 crore in the previous year. [Transformative Capital](#)

Healthcare Infrastructure:

- The number of healthcare facilities, including hospitals, diagnostic centers, and rehabilitation centers, has been increasing, with over 65 key performance indicators (KPIs) covering statistics by ownership, specialty, and location. [GlobeNewswire](#)

Employment in Healthcare:

- The healthcare sector is a major employer in India, supporting over **7.5 million jobs** by 2024. [Wright Research](#)

Technological Advancements:

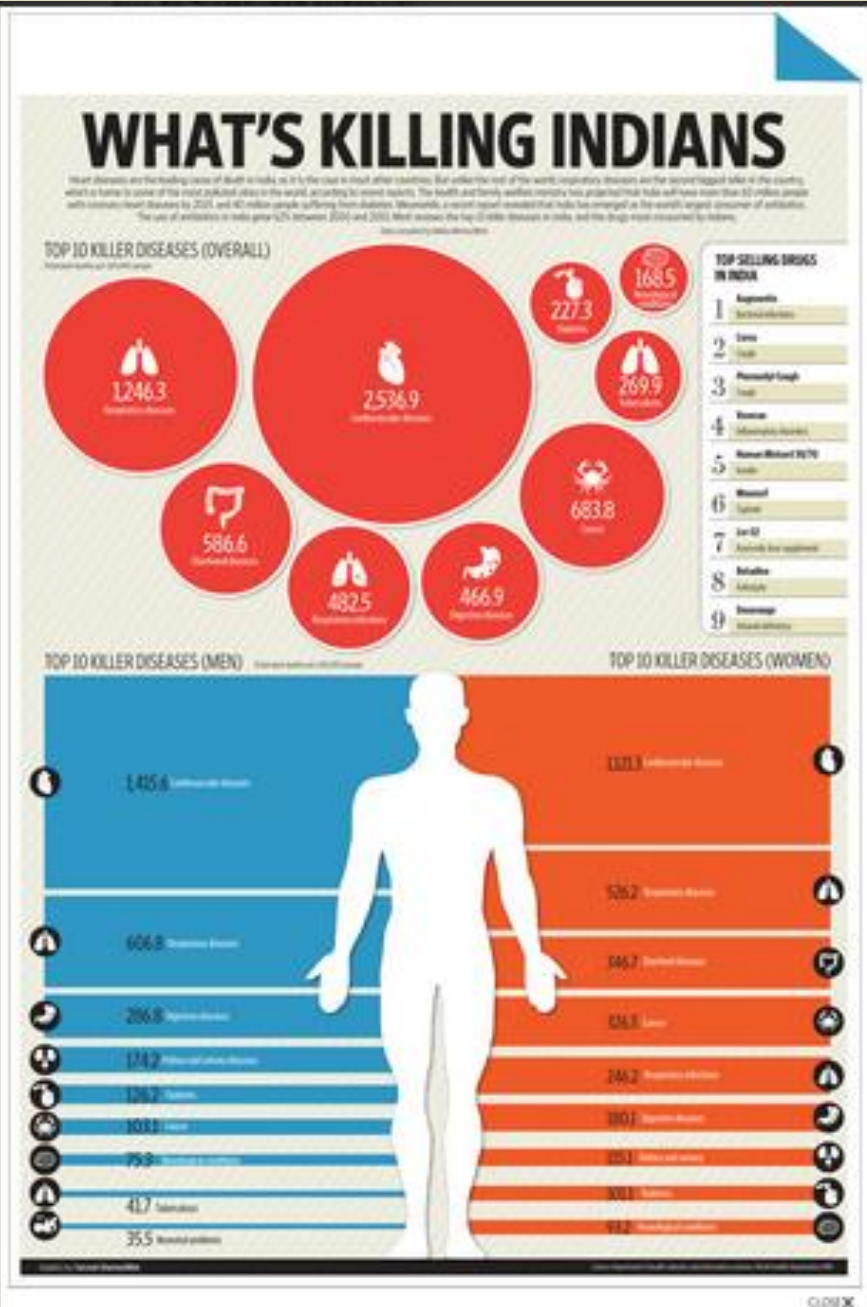
- Healthcare leaders in India are adopting new care delivery models and artificial intelligence-enabled innovations to enhance healthcare services. [Philips India](#)

Health Indicators:

- Life expectancy at birth in India has been steadily increasing, with the latest estimates indicating continued improvement. [datadot](#)

These developments underscore India's ongoing efforts to strengthen its healthcare system, aiming for universal health coverage and improved health outcomes for its citizens.

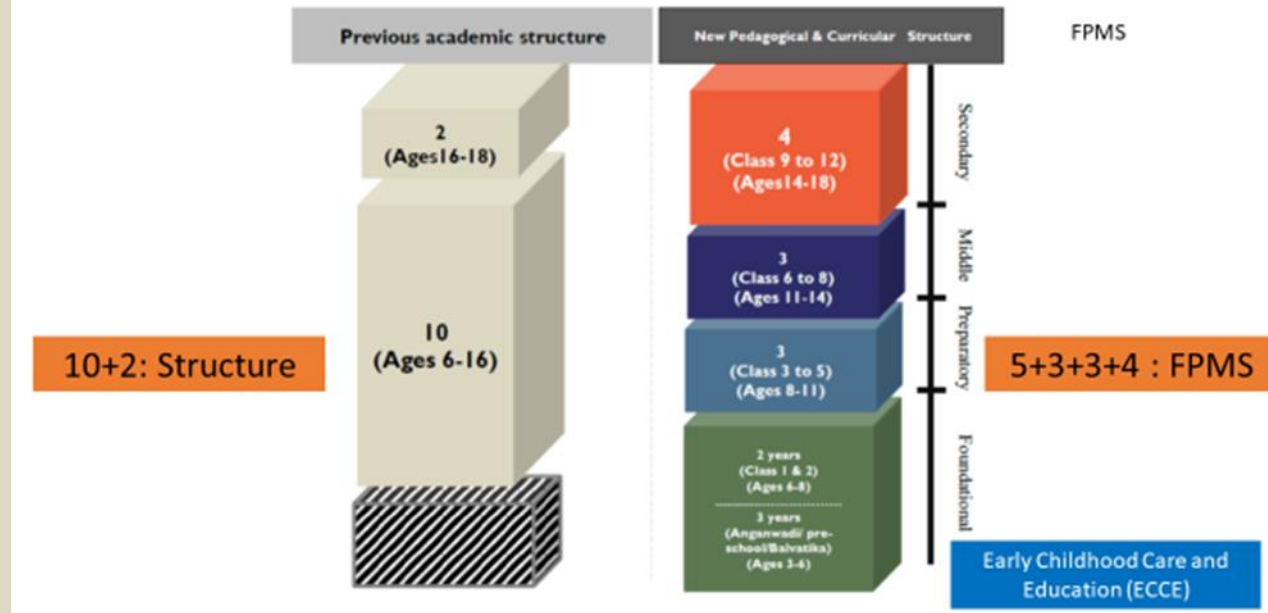
India Expands Free Health Coverage for Seniors



Higher Education in India



NEP-School Education



As of 2024, India's educational infrastructure encompasses a vast network of institutions across various levels. Below is a table summarizing the number of primary and secondary schools, colleges, and universities, along with their classifications:

Category	Number of Institutions
Primary Schools	1,489,000
Secondary Schools	150,000
Colleges	50,577
Universities	1,265
- Central Universities	54
- State Universities	416
- Deemed Universities	125
- Private Universities	361
Institutions of National Importance	159

As of 2024, India's higher education landscape has experienced significant growth and transformation, reflecting the nation's commitment to expanding educational opportunities and improving quality.

Enrollment Statistics:

- The total number of students enrolled in higher education institutions has reached approximately **43.3 million**, marking an increase of nearly 2 million from the previous year. [British Council](#)
- Undergraduate programs account for nearly **79%** of total enrollments, while **12%** of students are pursuing postgraduate (master's degree) courses. [British Council](#)
- Doctoral (PhD) candidates constitute about **0.5%** of the student population, with the remaining students enrolled in diploma and certificate programs. [British Council](#)

Market Growth:

- The Indian higher education market generated a revenue of approximately **\$19.42 billion** in 2023 and is projected to reach **\$54.37 billion** by 2030, exhibiting a compound annual growth rate (CAGR) of **15.8%** from 2024 to 2030. [Grand View Research](#)
- The **offline mode** remains the largest revenue-generating segment as of 2023, while the **online mode** is anticipated to register the fastest growth during the forecast period. [Grand View Research](#)

International Presence:

- Over **1.33 million** Indian students are pursuing higher education abroad in 2024, reflecting a growing trend in international education. [The PIE News](#)

Challenges:

- Despite the expansion, challenges persist, including aligning educational outcomes with labor market needs and ensuring equitable access across diverse socio-economic groups.
- These developments underscore India's dynamic higher education sector, characterized by rapid growth, increasing international engagement, and ongoing efforts to enhance quality and accessibility.

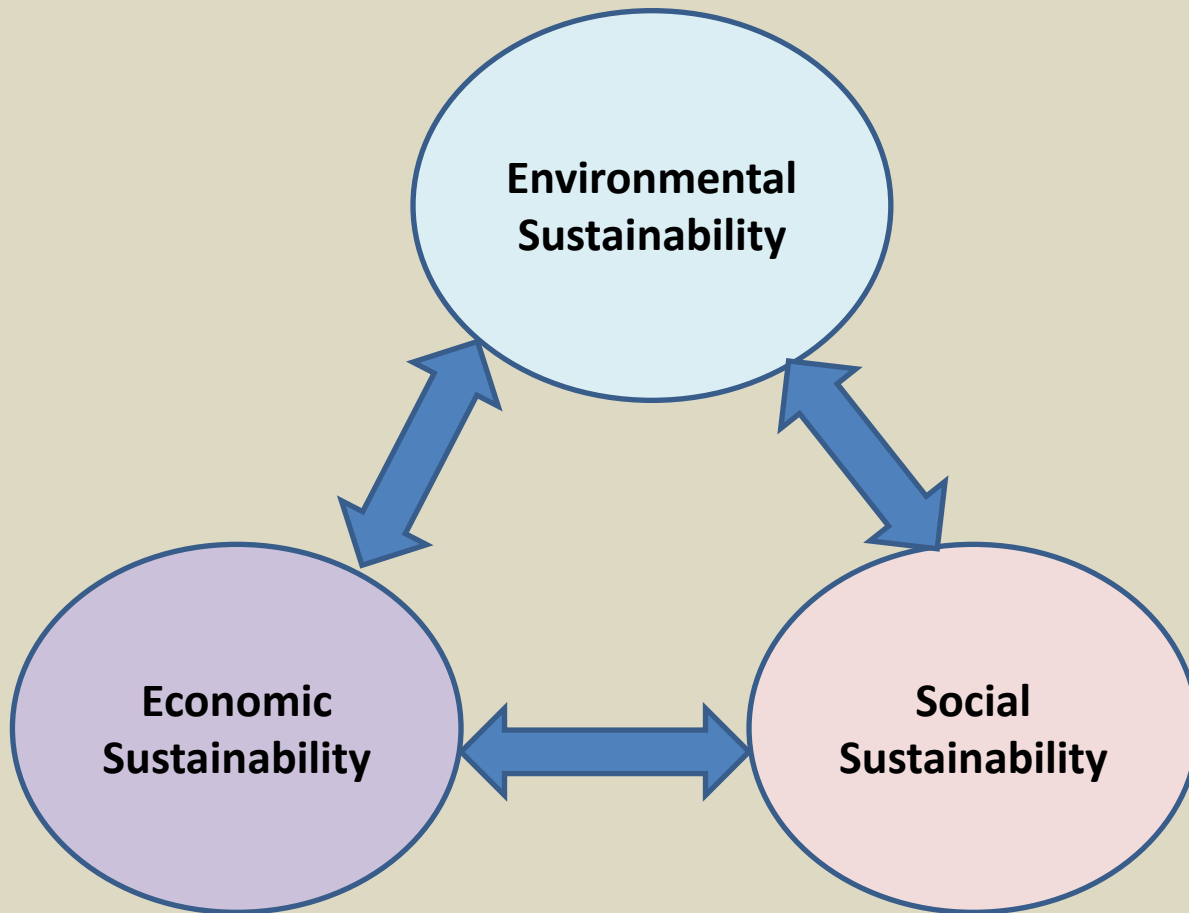
Major Challenges in India (Local to India)

- **Over Population**
 - It is expected that the population of India would grow to 1.5 Billion in 2030; this over population could lead to pollution, traffic, shortage of drinking water and food
- **Poverty**
 - Inclusiveness: Rich and Poor Gap
- **Food**
 - Land Degradation, Organic Food, Automation in Agriculture, Irrigation
- **Affordable Healthcare**
- **Energy Demand**
- **Education**
 - Quality Higher Education for 21st Knowledge Society
- **Employment**
 - Industrialisation,
- **Urbanisation**
 - Urban Infrastructure- Housing, Roads, Traffic, Power, Water, Sanitation,
- **Resources**
 - Roads, Electric Power, Energy Resources, Mass Transit

Major Challenges in India (Local to India)

- Religious Violences
- National Security
- National Disasters and Environmental Problems
- Government Policies
- Unethical Practices

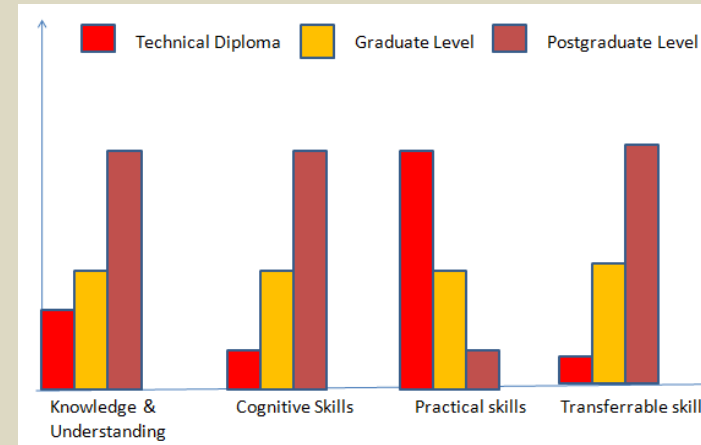
Sustainable Development Essential



- Sustainable development is about human development where resources meet the human needs without destroying the environment, such that needs can be met in the present and also for generations to come
- Economic sustainability is like running a business operation over the number of years while consistently returning a profit
- Social sustainability is about equity, diversity, social cohesions, quality of life, democracy and governance, maturity
- Environmental Sustainability is preserving the capability of the environment to support human life

Problem Solvers for Sustainable Development

- Expectations of Higher Education
 - Knowledge and Understanding in a chosen Domain
 - Cognitive Skills: Able to apply the knowledge and understanding gained for designing new systems in the domain
 - Practical Skills: develop/manufacture and test the systems
 - Transferrable Skills: able to learn new things, critical , analytical, problem solving, communication, team Work, information management, soft skills and leadership skills
 - Should have a knowledge of history, culture and Ethics



Diploma Level

Problem Definition:
Fabricate a System and Test

Graduate Level

Problem Definition:
Design and Develop a System

Postgraduate Level

Problem Definition:
Model, Simulate, Analyse, and
Validate the System

Engineers and Technologists are required to Solve
the Problems for Improvement of Life

Problems To Be Solved

Problems To Be Solved

- Clean Water
- Sanitation
- Secure, Safe and Healthy Food
- Shelter Technologies
- Solid Waste Management
- Textiles and Clothing Technologies
- Green Energy Technologies
- Education Technologies
- Healthcare Technologies
- Roads, Transport, Buildings and Communication
- Mass Transport Systems

Problems To Be Solved

- Agricultural Technologies
- Additive Manufacturing
- Advanced Materials
- Advanced Automotive Technologies
- Recreation and Leisure Technologies
- Warfare
- Genomics, Drug Development and Drug Delivery
- Biomedical Devices
- Bigdata Management and Analysis
- Machine Learning and Intelligent Systems
- Internet of Things
- Secure Cyberspace
- Climatic Disasters
- Enhanced Virtual Reality
- Reverse Engineer the Brain
- Engineer the Tool for Scientific Discovery
- Aircrafts
- Advanced Space Exploration

Clean Water- Technologies

Clean Water	Nanotechnology in filtration
	Membrane chemistry
	Seawater desalination
	Wastewater processing
	Mobile recycling facilities
	Underwater Resources and Issues

Useful Videos

- <https://www.youtube.com/watch?v=rXepkIWPhFQ>
- <https://www.youtube.com/watch?v=FbDJr6M0uPY>
- <https://www.youtube.com/watch?v=JL3y1CWhirQ>
- <https://www.youtube.com/watch?v=kr5BQjB013Q>

Sanitation

What goes OUT of a sanitation system?

Blackwater

Blackwater- mixture of urine, faeces, flushing water, anal cleansing water, dry cleansing material

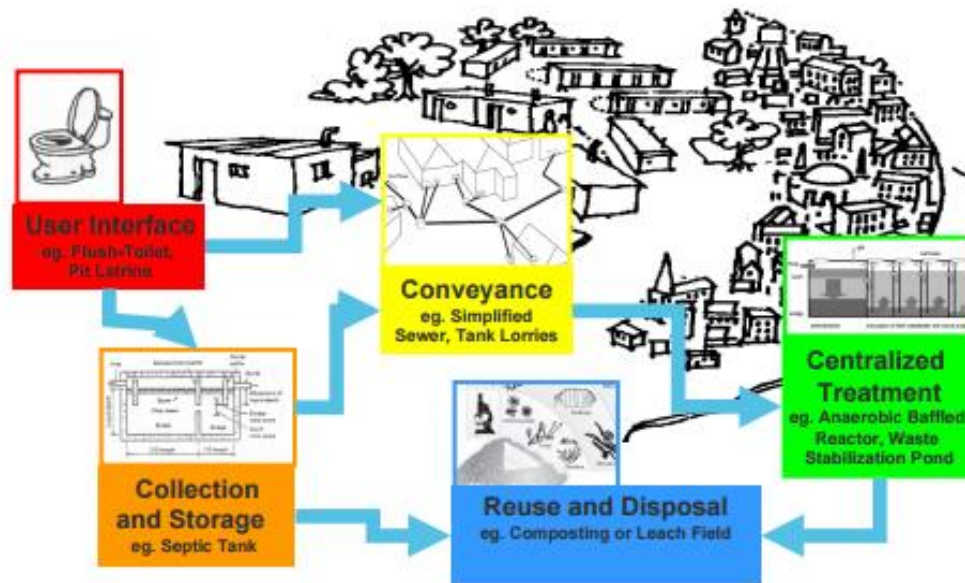
Faecal sludge

Faecal Sludge- undigested, or partially digested slurry or solid that results from the storage or treatment of blackwater or excreta

Compost/
Humus

Compost/Humus is the earth-like, brown/black material that is the result of decomposed organic matter

Processes of sanitation systems



Useful/Interesting videos

<https://www.youtube.com/watch?v=GEAhP4OK0c8>

<https://www.youtube.com/watch?v=GRyjH2eoj8w>

<https://www.youtube.com/watch?v=Of95mx1dgnY>

<https://www.youtube.com/watch?v=pRaptzcp9G4>

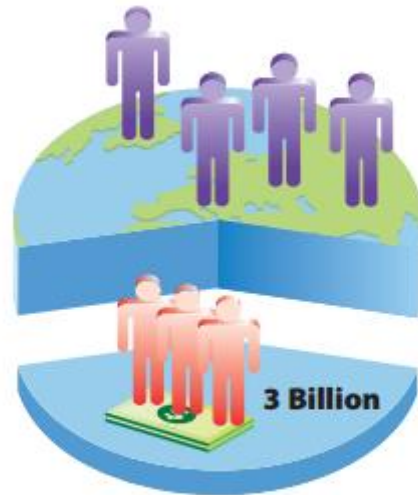
Safe, Secure and Healthy Food

Making safe, affordable and abundant food a global reality

Highly efficient food production can help end world hunger, lower food costs, protect consumer rights and safeguard our natural resources. Achieving this requires protecting rights of the entire food chain to use new and existing technologies while sustaining consumer choice.

Jeff Simmons, Elanco

**43 percent of the World's Population
Lives on Less Than US\$2/Day¹⁶**

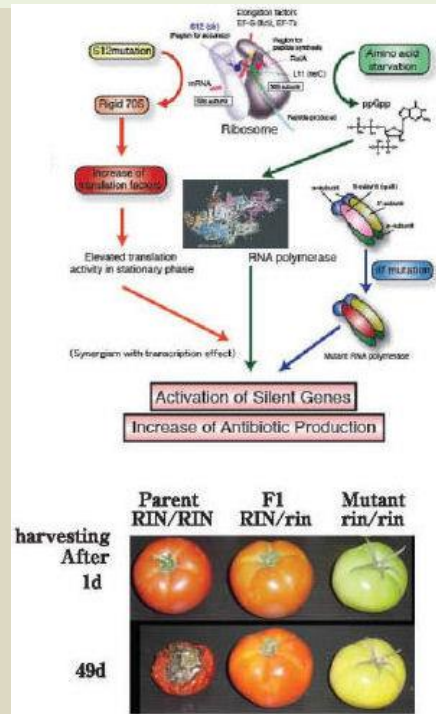


Affordable food can be a matter of life and death to the 3 billion people in the world who must live on less than US\$2/day.

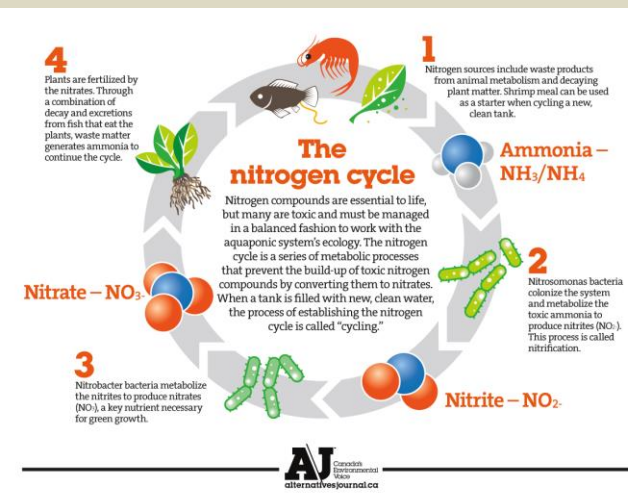
- [Useful Videos](#)
- <https://www.youtube.com/watch?v=ONkKy68HEIM>
- <https://www.youtube.com/watch?v=gekwmvnGtWI>

Safe, Secure and Healthy Food

Food biotechnology is a branch of food science that seeks to improve foods and food production. Biotechnological processes include industrial fermentation, plant cultures and genetic engineering.



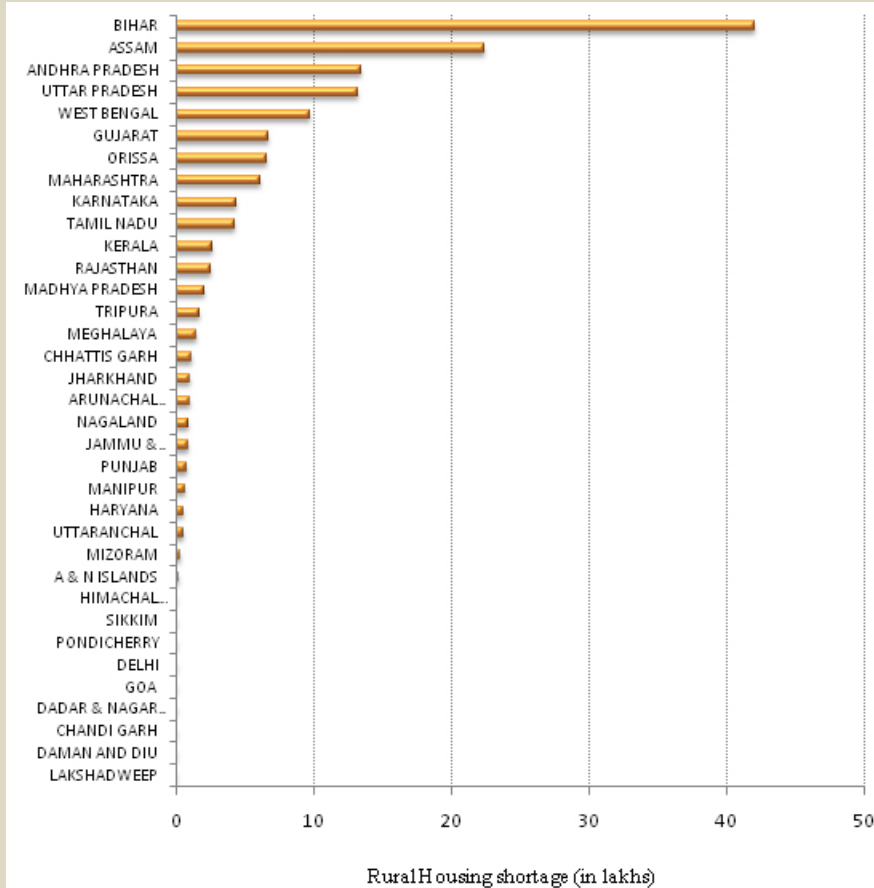
Agricultural technology, application of techniques to control the growth and harvesting of animal and vegetable products.



Food technology is a branch of food science that deals with the production processes that make foods. Early scientific research into food technology concentrated on food preservation.



Shelter Technologies



State wise shortage of housing in rural areas

- Waterproofing of Buildings
- Low cost construction technologies for hilly regions
- CBRI pre-cast building component technology
- Repairs and strengthening of earthquake affected houses
- Low cost building materials & technologies
- Rural housing and sanitation
- Brick production technologies

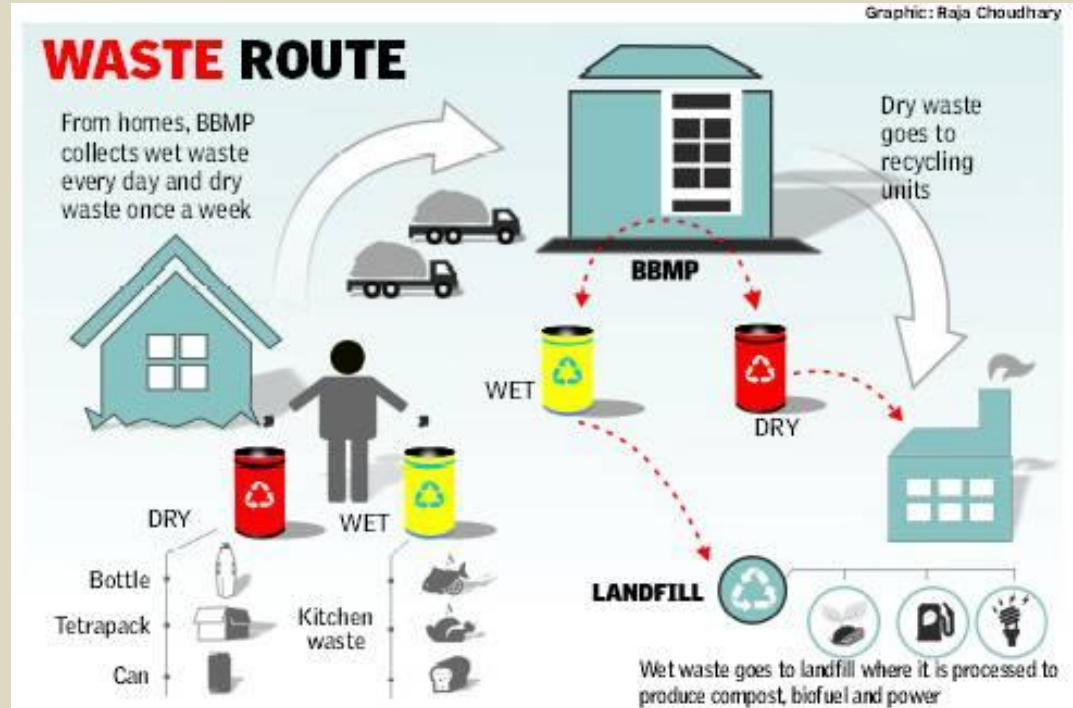


Interesting Video

<https://www.youtube.com/watch?v=uZtRf-chi00>

<https://www.youtube.com/watch?v=0tsqK5pbxcs>

Solid Waste Management



- www.youtube.com/watch?v=T7rkj9Ai1Y8
- <https://www.youtube.com/watch?v=kwTl2wy4UcM>
- <https://www.youtube.com/watch?v=v7Ut3Mq8q9g>

Textiles and Clothing Technologies

chenille damask taffeta
cashmere gabardine linen
satin ticking seersucker damask
flannel gingham broadcloth
brocade COTTON WOOL
organza velveteen silk
houndstooth denim twill



- <https://www.youtube.com/watch?v=XCsGLWrfE4Y>
- <https://www.youtube.com/watch?v=d2TAC9VpJVE>
- <https://www.youtube.com/watch?v=9ctD5jjMeY8>

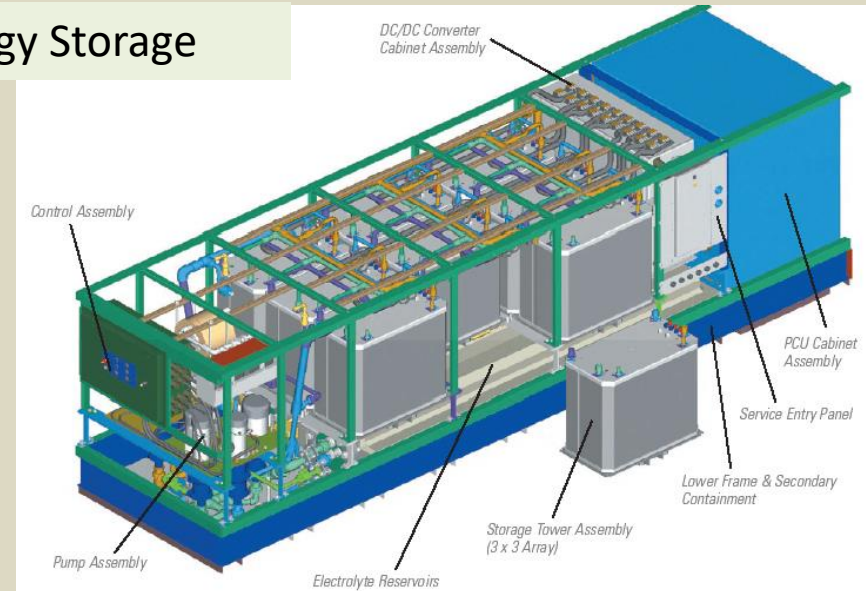
Green Energy Technologies



- Green Energy

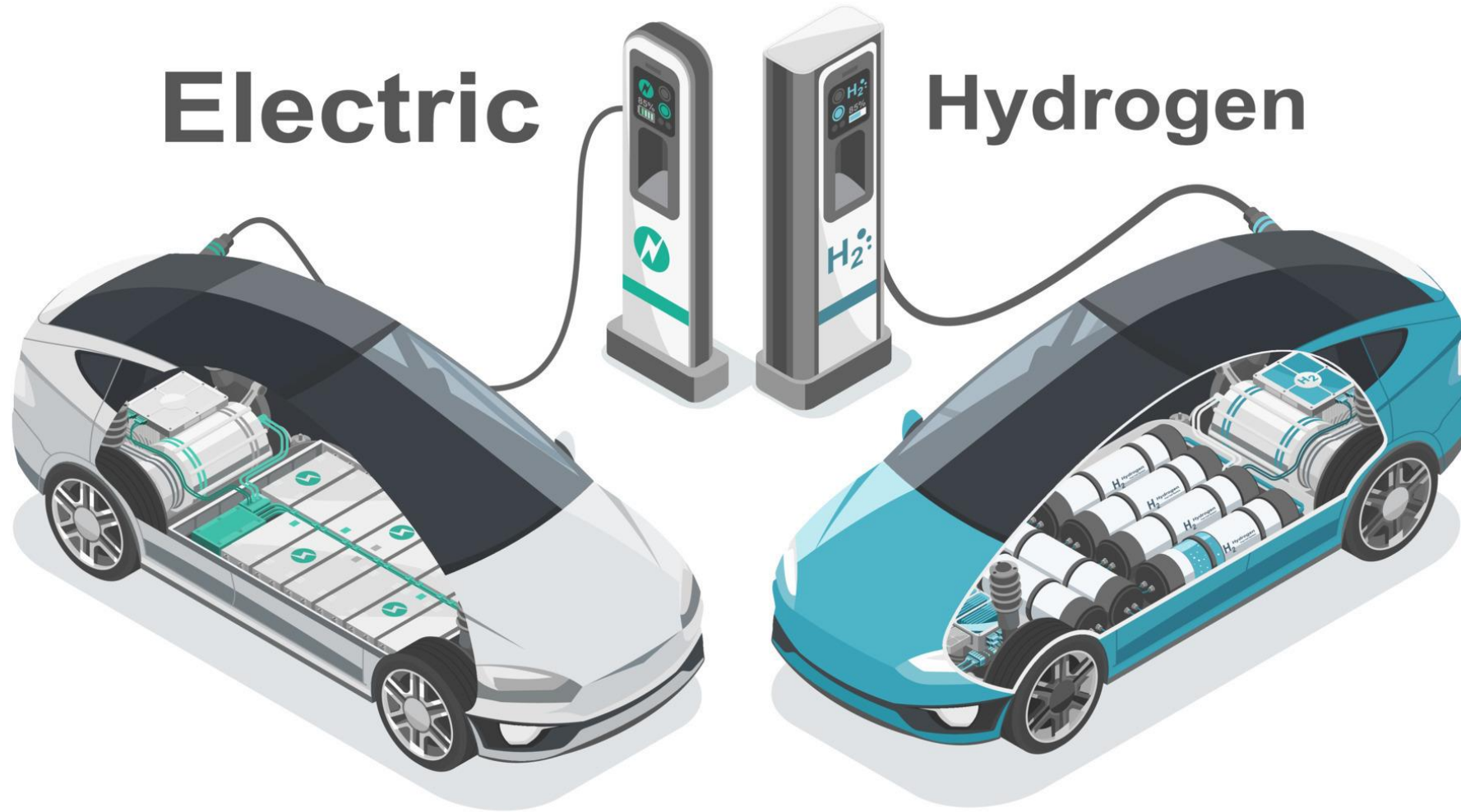
<https://www.youtube.com/watch?v=0KhDUz13kBc>

- Energy Storage



Smart Grid

Hydrogen and Fuel Cell



Education Technologies

India's education sector needs innovative technologies to address challenges such as equitable access, quality of learning, teacher training, and skill development. Below are some **key educational technologies** that can revolutionize education in India:

1. Digital Infrastructure for Learning

- **Smart Classrooms:** Equip classrooms with interactive whiteboards, projectors, and digital learning tools.
- **High-Speed Internet:** Ensure broadband connectivity in rural and remote areas.
- **EdTech Platforms:** Platforms like BYJU'S, Vedantu, and Khan Academy to scale personalized learning.

2. AI-Driven Personalized Learning

- **Adaptive Learning Platforms:** AI-powered systems to customize educational content based on a student's learning pace and style.
- **AI Tutors:** Virtual tutors providing real-time assistance and guidance.

3. Virtual and Augmented Reality (VR/AR)

- **Immersive Learning Experiences:** AR/VR tools to simulate real-world scenarios for subjects like history, science, and engineering.
- **Skill-Based Training:** VR simulations for medical, mechanical, and industrial skills training.

4. Learning Management Systems (LMS)

- Platforms like Moodle or Blackboard to streamline teaching, assignments, and assessments.
- **Analytics Tools:** Data-driven insights into student performance for teachers and administrators.

5. Mobile Learning and Microlearning

- **Mobile Apps:** Learning through smartphones for rural and underserved regions.
- **Short Learning Modules:** Bite-sized lessons for better engagement and retention.

6. Blockchain for Credentialing

- Secure and verifiable digital certifications for degrees, diplomas, and skills.
- Prevents fraudulent qualifications and simplifies verification processes.

7. Gamification and E-Gaming in Education

- Interactive games to teach concepts in math, science, and languages.
- Rewards and incentives for student progress.

8. Assistive Technologies

- Tools for students with disabilities:
 - **Text-to-Speech (TTS) Software**
 - **Speech-to-Text Applications**
 - **Screen Readers and Magnifiers**

9. EdTech for Vocational and Skill Development

- **AI and IoT Training:** Courses in AI, Machine Learning, IoT, and robotics for employability.
- **Skill-Based MOOCs:** Massive Open Online Courses focusing on vocational training.

10. Data Analytics in Education

- Predictive analytics for identifying at-risk students.
- Insight into curriculum effectiveness.

11. E-Libraries and Open Educational Resources (OERs)

- Access to a wide range of free educational content and research materials.
- Digital libraries like **National Digital Library of India (NDLI)**.

12. Cloud Computing

- Secure storage and access to educational resources anytime, anywhere.
- Enables collaboration between students and educators.

13. Hybrid Learning Models

- Combining online learning with traditional classroom teaching for flexible education delivery.

14. Language Learning Tools

- AI-based translation tools to bridge the gap for students from non-English speaking backgrounds.
- Tools to teach regional languages effectively.

15. Robotics and Automation in Schools

- Hands-on robotics kits and coding platforms for young learners.
- Fosters problem-solving and innovative thinking.

Implementation Challenges:

- **Digital Divide:** Limited internet and device access in rural areas.
- **Teacher Training:** Upskilling educators to use these technologies effectively.
- **Funding:** High initial costs for deploying technologies.
- **Content Localization:** Adapting content to diverse linguistic and cultural contexts.

Health Care Technologies

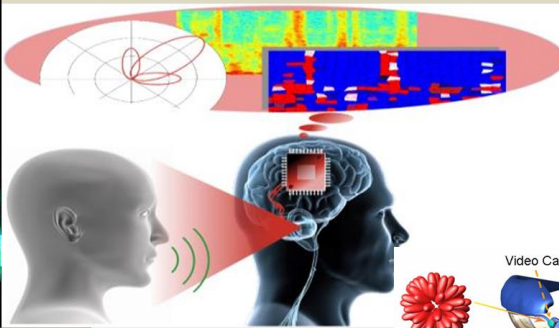
1. Intelligent Pills Deliver Medication to Specific Locations
2. Sensor Technology Tracks Medication Adherence
3. Brain Implants Prevent Seizures
4. Contact Lens Detects Glaucoma
5. Artificial Pancreas for Diabetics
6. Printing New Skin
7. Artificial Retina
8. Video Games Hone Medical Student Decision-Making Skills
9. Robot Care Givers
10. Lab-on-a-Chip

<https://www.youtube.com/watch?v=totMfYaq8O8>

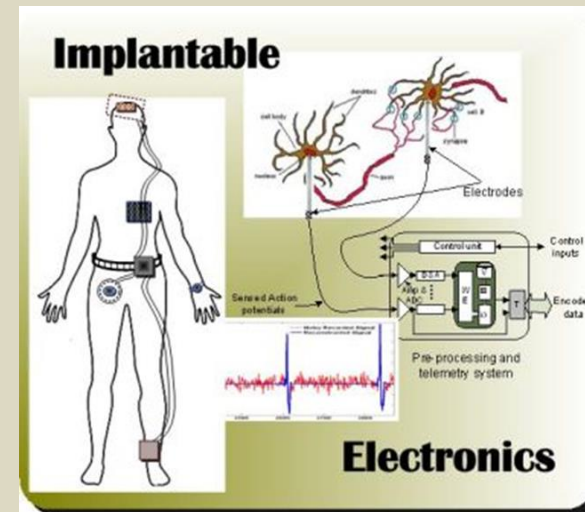
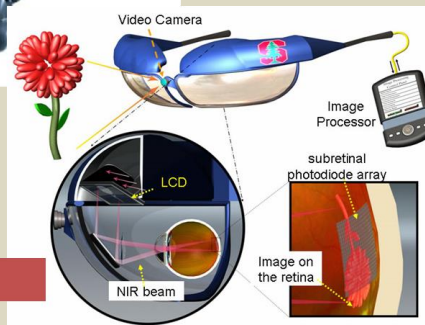
<https://www.youtube.com/watch?v=Xhn7Jkc7Ma8>



Neuro-prosthetics

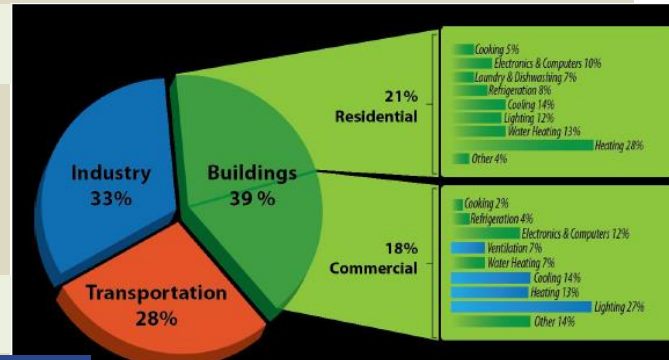


Retinal Prosthetics



Buildings, Roads, Transport, Communication

Sustainable Buildings



Sustainable Cities



SB13 Manila
Regional SB Series – SE Asia

Sustainable Buildings, Infrastructure & Communities
Sustainability & Resilience, Climate Mitigation & Adaptation

25-27 Nov 2013
Metro Manila, Philippines



DESIGN STRATEGIES

the largest energy reductions can be achieved through design.



TECHNOLOGIES AND SYSTEMS

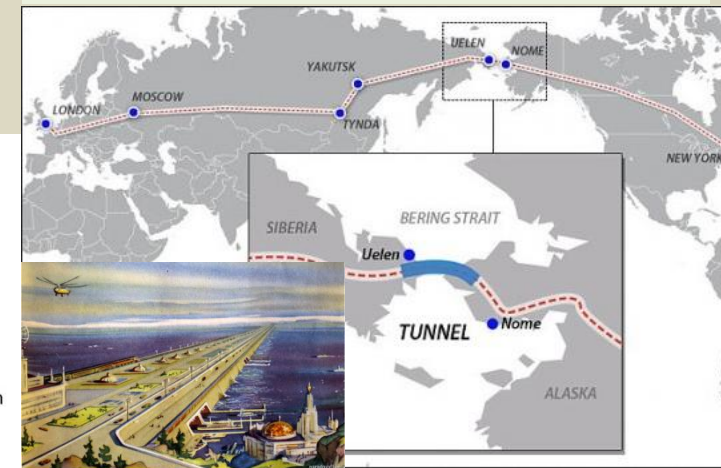
Including on-site renewable energy systems.



OFF-SITE RENEWABLE ENERGY

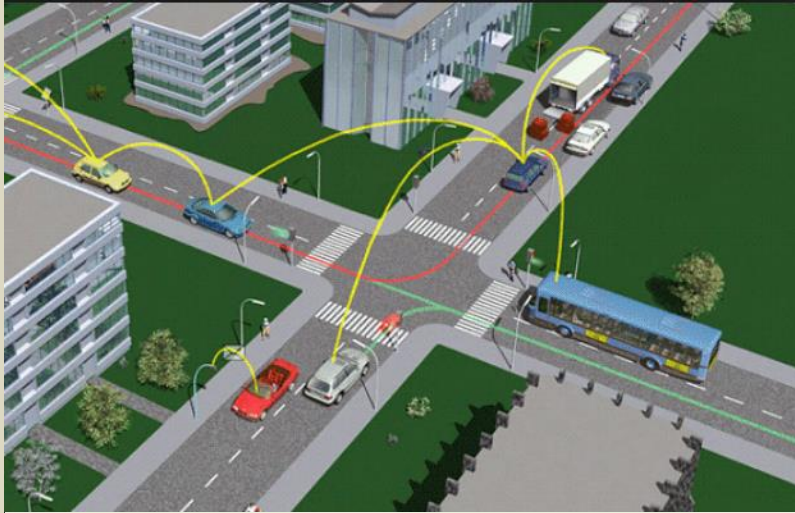
20% maximum.

Designing Large Infrastructure



Buildings, Roads, Transport, Communication

Green Vehicles



Intelligent Transportation

Intelligent transportation systems are projects that aim to integrate modern communication and information technology into existing transportation management systems in order to optimize vehicle life, fuel efficiency, safety, and traffic in urbanized cities

CO₂ emission figure (g/km)

<100 A

101-120 B

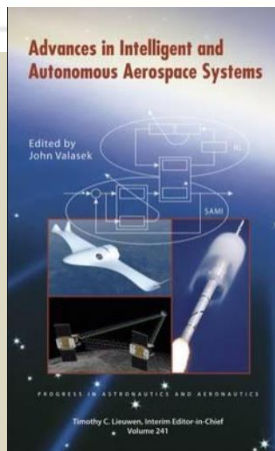
121 - 150 C

151 - 165 D

166 - 185 E

186 - 225 F

226+ G



Autonomous Aerospace Systems

Driverless Cars

<https://www.youtube.com/watch?v=oYOMZITjsQ0>

15 Futuristic Technologies You'll See In Your Lifetime

<https://www.youtube.com/watch?v=fJ4MXc5n8I8>

<https://www.youtube.com/watch?v=ptqPJGTsloM>

<https://www.youtube.com/watch?v=X7mqfu0OReY>

Mass Transport Systems



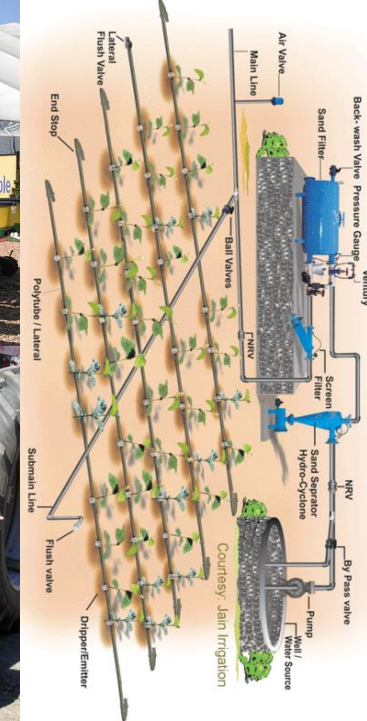
<https://www.youtube.com/watch?v=oYOmZITjsQ0>

<https://www.youtube.com/watch?v=FVP2hJQmc1c>

Agricultural Technologies



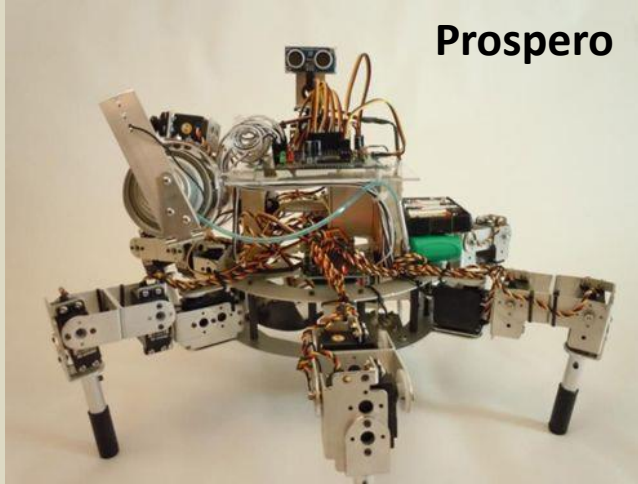
Agricultural Technologies



Agricultural Technologies



Agricultural Technologies



Agricultural Technologies

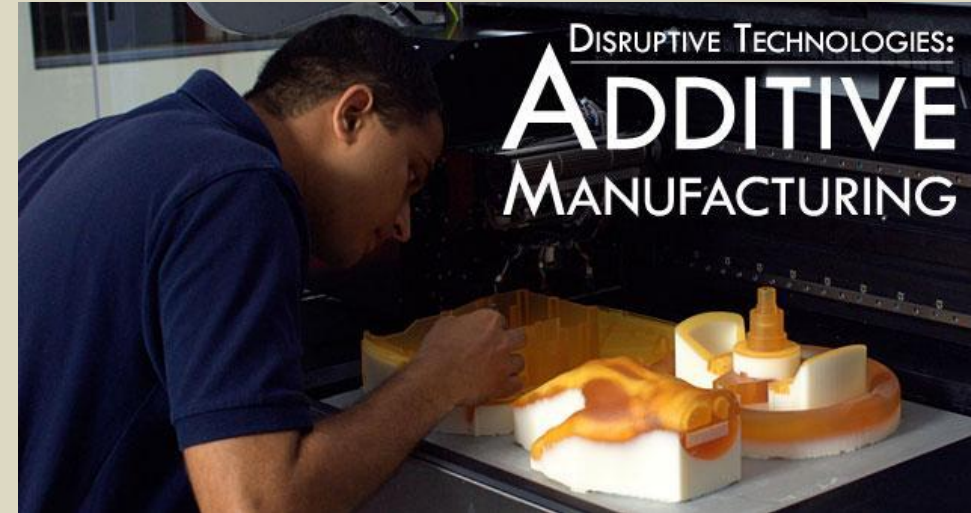
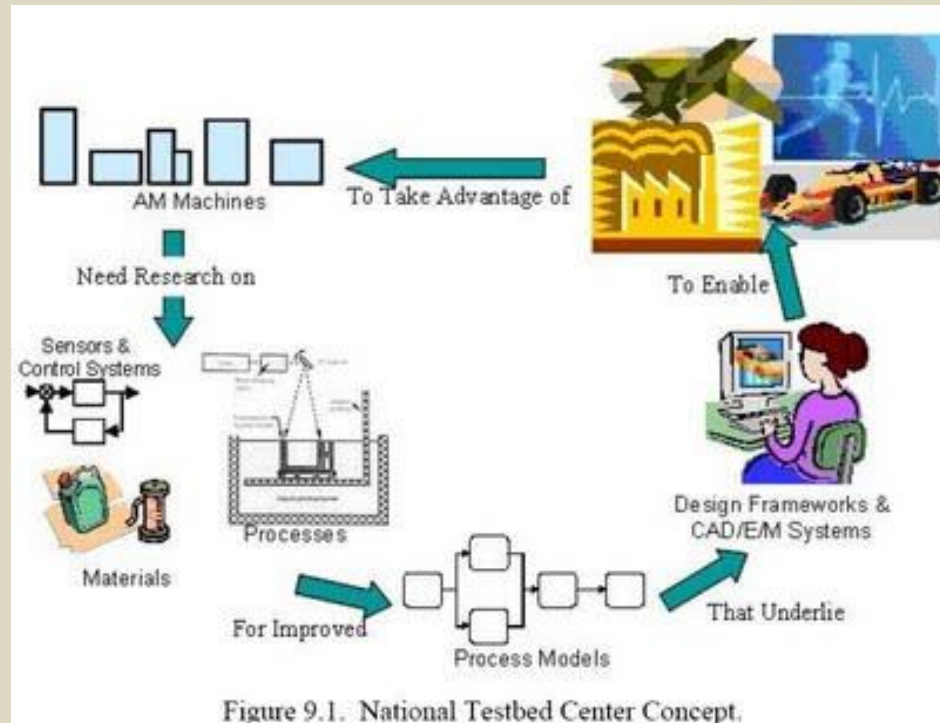
<https://www.youtube.com/watch?v=N1SyMTODdrA>

<https://www.youtube.com/watch?v=nhVWNwCRpKg>

<https://www.youtube.com/watch?v=C4LSWrhEsmA>

<https://www.youtube.com/watch?v=T0cPc4MCEOQ&list=PLRrsGL5NwwWVAwiJeNxfTfpHacNjaeOSU>

Additive Manufacturing



<https://www.youtube.com/watch?v=A4iyLlaOOof0>

<https://www.youtube.com/watch?v=vgGenOdq9iY>

Advanced Materials

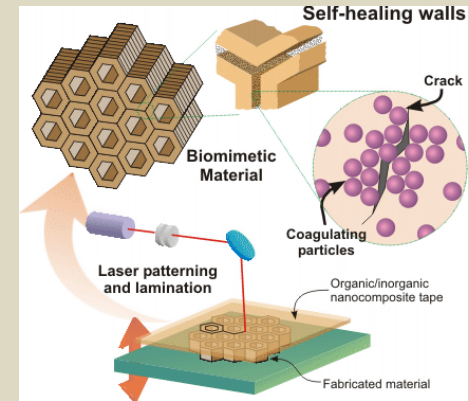


- Aerospace Materials

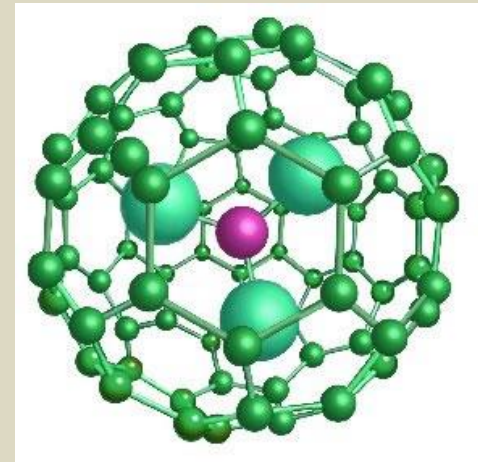


<https://www.youtube.com/watch?v=wMLvodIVYNI>
<https://www.youtube.com/watch?v=JDwnjfYYxrE>
<https://www.youtube.com/watch?v=i6n8cpLKzHE>

- Bio-inspired Materials



- Nano-materials



Advanced Automotive Technologies

<https://www.youtube.com/watch?v=z6-afABCD1M>

<https://www.youtube.com/watch?v=igvW0DxIFnw>

<https://www.youtube.com/watch?v=tzPtWCN5l5c>

https://www.youtube.com/watch?v=8YHJyDtsS_A

Recreation and Leisure Technologies

<https://www.youtube.com/watch?v=F0Ypz9TDMTE>

Warfare

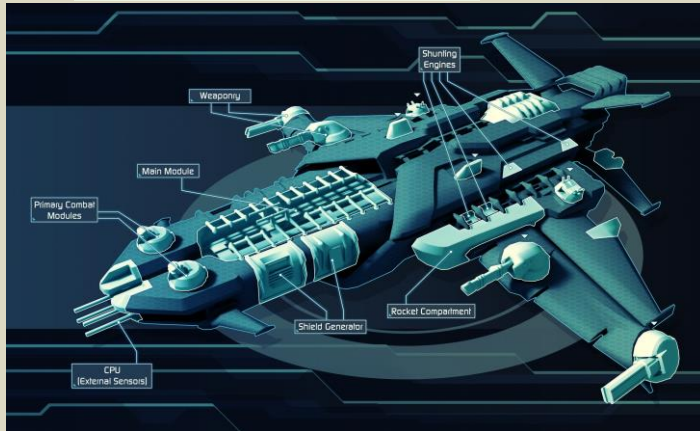
1. 'Sentient' Unmanned Vehicles



2. Hypersonic Cruise Missiles and 'Prompt Global Strike'



3. Space Weapons



4. Electromagnetic Rail Guns



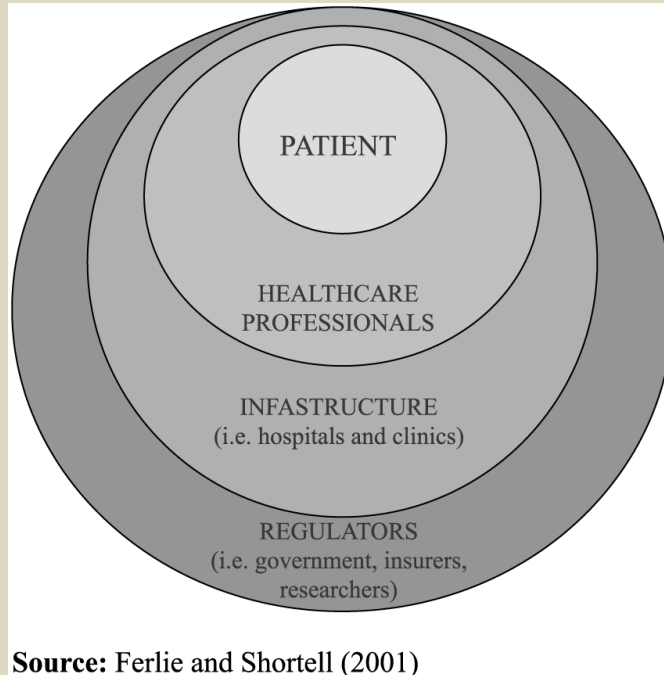
5. 'Hyper Stealth' or 'Quantum Stealth'



<https://www.youtube.com/watch?v=AHudy-pnxJQ>

https://www.youtube.com/watch?v=C95_yF82PPc

Genomics, Drug Development and Drug Delivery



Healthcare Delivery

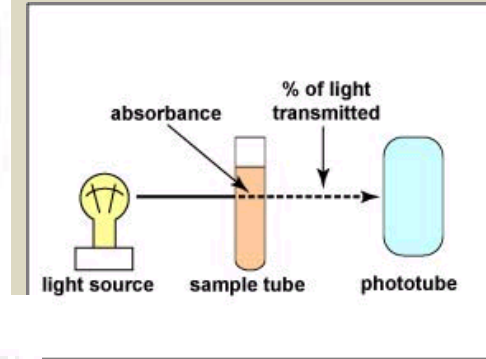


<https://www.youtube.com/watch?v=BoUS65mxnIE>

<https://www.youtube.com/watch?v=g7b3JfiWS6c>

<https://www.youtube.com/watch?v=BBANZxYxXM8>

Biomedical Devices



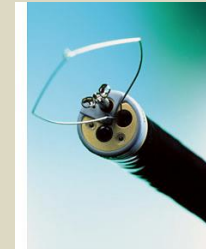
Medical Laboratory Devices



ECG s.manometer



lung capacity
using a spirometer.



Medical Imaging Devices



Ultrasound
therapy unit

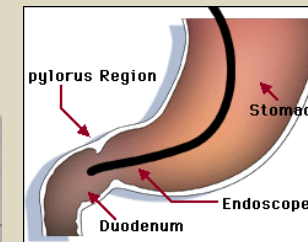
Many more



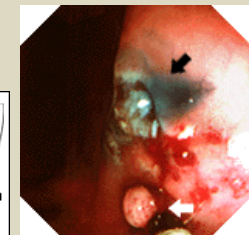
Linear
accelerat
or



Leksell gamma knife

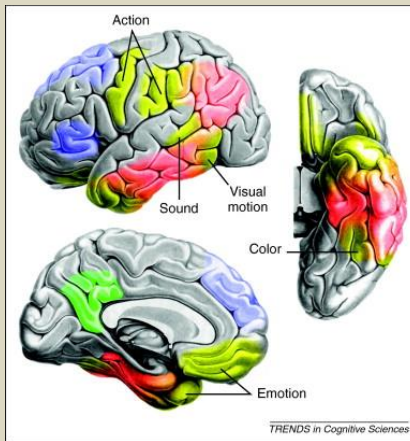
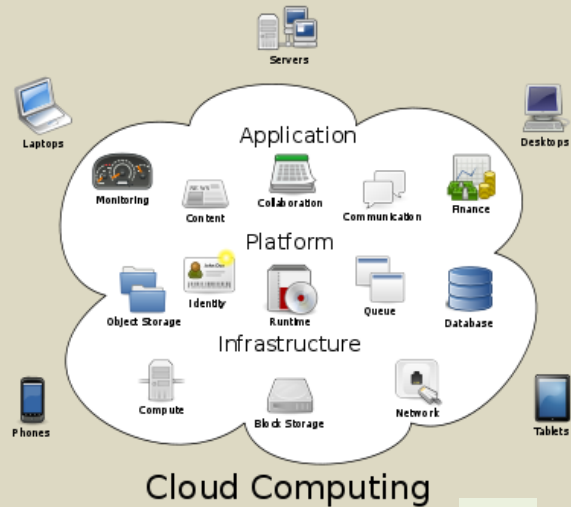


Endoscopy



https://www.youtube.com/watch?v=HneI7_Zselc&list=PL5EA8CBB786085A6D

Bigdata Management and Analysis



Semantic Processing



- Massive Data Management

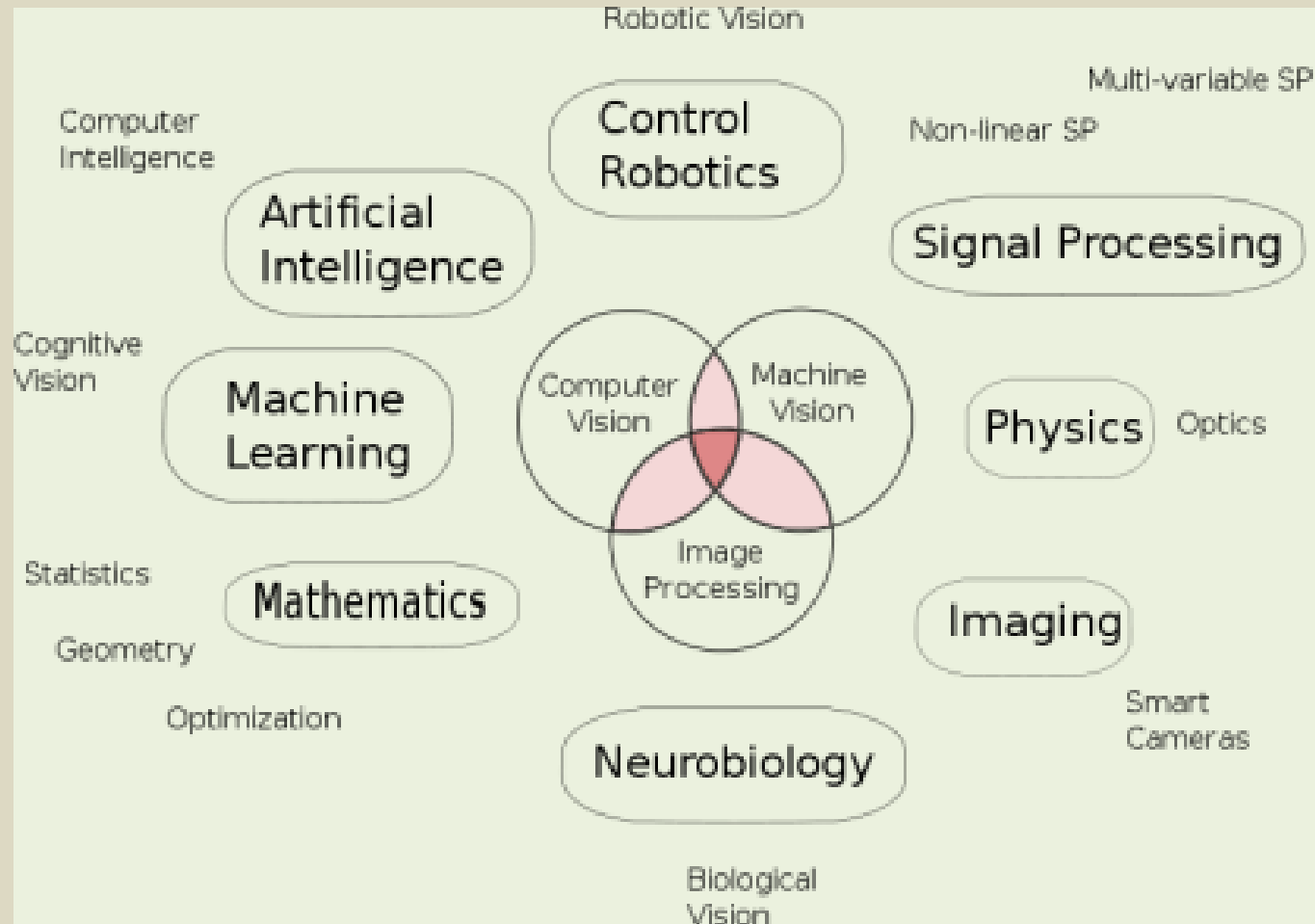
<https://www.youtube.com/watch?v=c4BwefH5Ve8>

<https://www.youtube.com/watch?v=ceeiUAmbfZk>

<https://www.youtube.com/watch?v=qbhMpthdWDM>

<https://www.youtube.com/watch?v=t4wtzluoY0w>

Machine Learning and Intelligent Systems

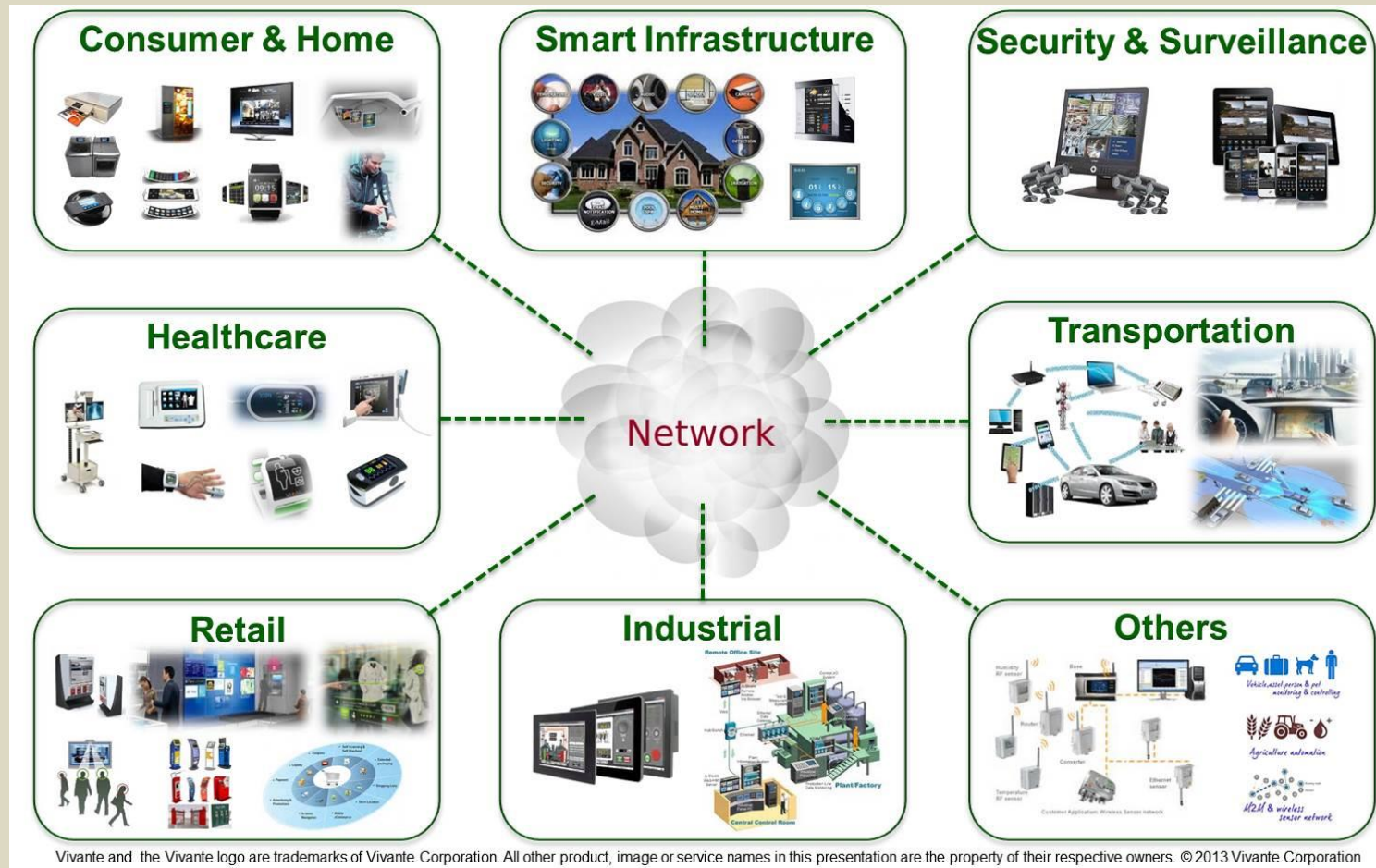


<https://www.youtube.com/watch?v=YpVSuBS6M7U>

<https://www.youtube.com/watch?v=oYqXQw2CryI>

<https://www.youtube.com/watch?v=vU8NeMI044k>

Internet of Things



<https://www.youtube.com/watch?v=QaTIt1C5R-M>

<https://www.youtube.com/watch?v=fFqEx--b7hU>

https://www.youtube.com/watch?v=M_uBobyu3vY

<https://www.youtube.com/watch?v=eMdqYdCMi9Q>

Secure Cyberspace



<https://www.youtube.com/watch?v=0p3787JiFgQ>

<https://www.youtube.com/watch?v=MA8c6NDaao4>

Climatic Disasters



<https://www.youtube.com/watch?v=M1H2uO5IK5I>

<https://www.youtube.com/watch?v=Sx6vuSr9l34>

<https://www.youtube.com/watch?v=pCYfQmk5yao>

Enhanced Virtual Reality

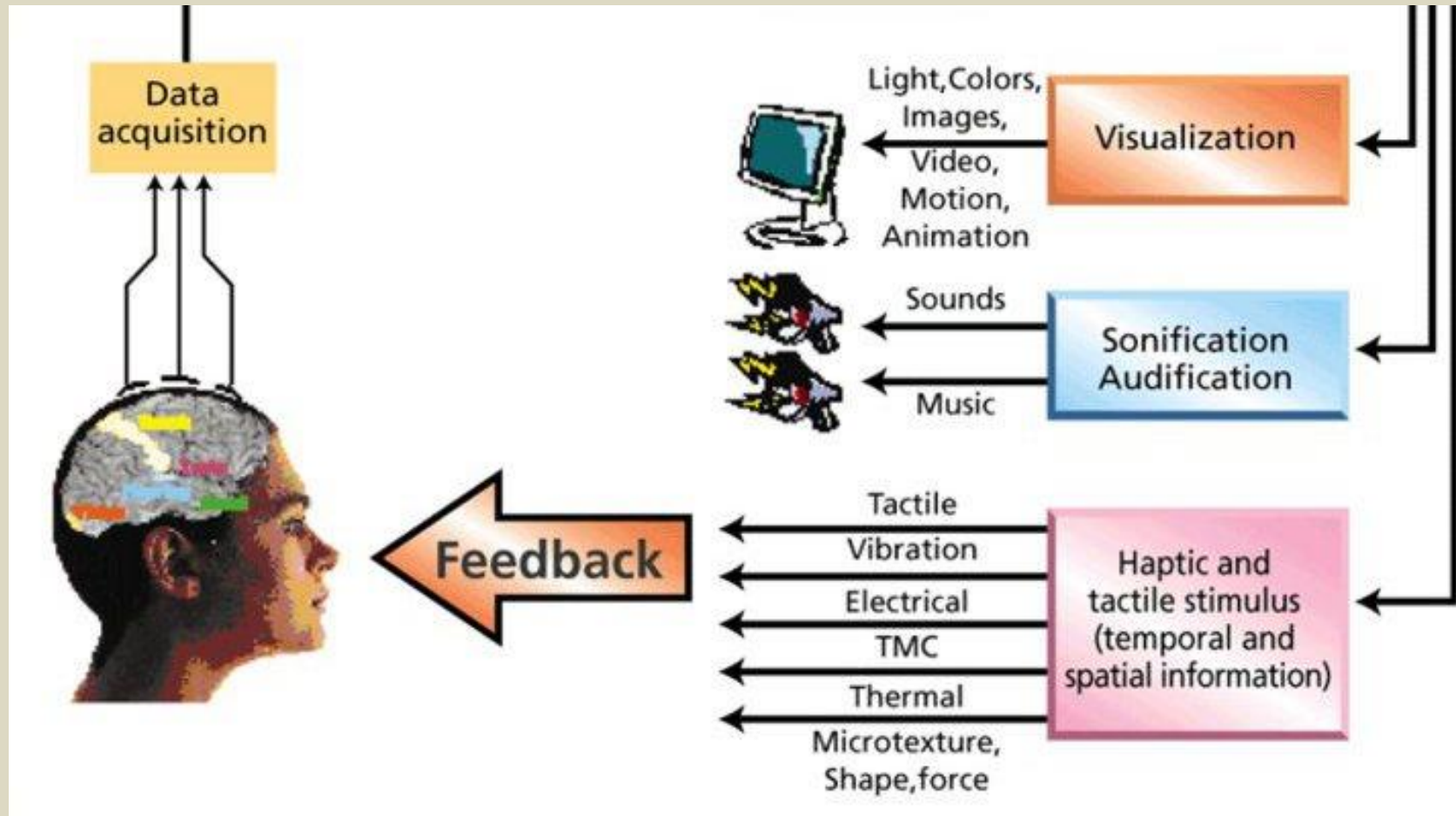


<https://www.youtube.com/watch?v=i4Zt3JZeibg>

<https://www.youtube.com/watch?v=9ypIHQhaVXU>

<https://www.youtube.com/watch?v=JVWQWetoNtM>

Reverse Engineer the Brain



<https://www.youtube.com/watch?v=VTxQsm2JeLg>

https://www.youtube.com/watch?v=IM_k_c6Uj0A

<https://www.youtube.com/watch?v=NmgZDfq0HZo>

Aircrafts



<https://www.youtube.com/watch?v=6gTM-amoosc>

<https://www.youtube.com/watch?v=VJ0I773sFbw>

<https://www.youtube.com/watch?v=3OMWPoXg454>

<https://www.youtube.com/watch?v=oZrpngSooyA>

Advanced Space Exploration



<https://www.youtube.com/watch?v=ZtaKWt26dNs>

<https://www.youtube.com/watch?v=GVtm0loi9OY>

<https://www.youtube.com/watch?v=dyyOcL5tn7k>

<https://www.youtube.com/watch?v=mMqRxLzKzu8>

Dr. S. R. Shankapal is a distinguished academic and engineering professional with a Mechanical Engineering degree from the University of Mysore (MCE-Hassan), a postgraduate degree from IIT Madras, and a PhD from BITS Pilani. Currently the Vice Chancellor of GM University, Davanagere, he previously served as the founding Vice Chancellor of M.S. Ramaiah University of Applied Sciences and led M.S. Ramaiah School of Advanced Studies for 14 years. With expertise in Control Systems, Vehicle Dynamics, and Automotive Powertrain, he has secured over Rs. 100 million in research grants and an incubation grant of Rs. 525 lakhs. He has published over 85 research papers, authored nine textbooks, and consulted on 500+ CAD/CAE projects, including 100 for DRDO. A recipient of numerous awards, he has collaborated with global universities and professional bodies, championing outcome-based education and mentoring students at all levels.

GMU Knowledge Series

Sustainable Futures: Opportunities and Innovations for a Changing World -Dr. S. R. Shankapal

Published by:
GM University
Davanagere, Karnataka-577006
India
Year of Publication: 2025



GM UNIVERSITY

P.B.Road, Davanagere, Karnataka, India - 577006



Igniting
Innovation
Inspiring
Transformation

GM UNIVERSITY

- GM University is located in Davanagere, Karnataka, adjacent to the Deputy Commissioner's office along the Pune-Bangalore Highway. Situated approximately 262km from Bangalore. The university is well-connected by both train & bus routes to major cities across Karnataka. The GMU campus is just 4km from the Davanagere city centre.
- The University sponsored by Srishyla Educational Trust (SET) founded by Late G. Mallikarjunappa, established by the State of Karnataka through Act No. 19 of 2023, GM University builds on a legacy of over 20 years in higher education, originating from the GM Institute of Technology (GMIT), which was founded in 2001.
- GMIT is renowned for its quality engineering and technology programs. GM University was created to expand its educational offerings, addressing the challenges of 21st century education & fostering holistic development in students.
- The University also emphasizes research, Skill development and Entrepreneurship, providing students with opportunities to engage in Innovation, business incubation, and technical consultancy. Through its integrated approach, which includes extracurricular activities, interdisciplinary electives and strong focus on project-based learning, GMU aims to prepare its students for both local & global challenges.
- GMU's academic programs span diverse fields including Engineering, Computing, Basic & Applied Sciences, Commerce, Management, Legal Studies, Health Sciences, Humanities, Tourism & more.

☎ 93640 99720, 93640 99712, 63642 59993 | admissions@gmu.ac.in

GMU Advantage

- Outcome Based and Competency Driven Education
- Holistic Development Hub
- Global Immersion Programs
- Project Based and Experiential Learning
- Digital Campus for 21st Century Learning
- Innovation & Entrepreneurship Incubator

