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**{Bio – Disease – 19/08/16} Ebola outbreak in Congo**

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[IE](#) | [Source](#) | [The Hindu](#) | 16-08-2019 | Biology > [Diseases](#)

- WHO in July declared the Ebola outbreak in the Democratic Republic of Congo a Public Health Emergency of International Concern.

**Ebola Virus Disease (EVD)**

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- Ebola virus was first discovered in 1970s near the Ebola River in the Democratic Republic of Congo.
- Ebola Virus Disease (EVD) is a disease in **people and nonhuman primates** (monkeys, gorillas, chimpanzees).
- The Ebola virus (EBOV) is one among the four related species of the genus Ebolavirus.
- The viruses that cause EVD are located mainly in sub-Saharan Africa.
- Ebola virus spreads through **direct contact with an infected person or through direct contact with an infected animal** (bat or nonhuman primate).
- There is **no** approved vaccine or treatment for EVD.
- Symptoms of EVD include fever, headache, muscle pain, weakness, fatigue, diarrhoea, etc.
- Diagnosing can be **difficult as early symptoms are not specific to Ebola virus infection**.
- Recovery from EVD depends on good supportive care and the patient’s immune response.
- Ebola survivors may experience difficult side effects after their recovery, such as tiredness, muscle aches, etc.

**Congo’s Ebola outbreak may be controllable now**

- The haemorrhagic fever caused by the Ebola virus may finally be curable as two experimental drugs called REGN-EB3 and mAb114 have shown survival rates of as high as 90 per cent in a clinical trial.

## **{Bio – Diseases – 19/07/19} Rotavirus vaccine in UIP nationwide from September**

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[PIB](#) | [Biology](#) > [Diseases](#) | [GS2](#) > Issues related to health sector

- Government is committed to ending morbidity and mortality in children due to diarrhoea by 2022.
- In India, every year 37 out of every 1000 children born are unable to celebrate their 5th birthday, and one of the major reasons for this is diarrheal deaths.
- Out of all the causes of diarrhoea, **rotavirus** is a leading cause of diarrhoea in children.
- **Rotavirus vaccine** along with proper sanitation and hygiene, zinc supplementation and vitamin A supplementation will go a long way in reducing the mortality and morbidity due to diarrhoea in children.
- Keeping in view the burden of disease, National Technical Advisory Group on Immunization (NTAGI) recommended **introduction of rotavirus vaccine (RVV) in the Universal Immunization Programme (UIP)**.
- Three doses of rotavirus vaccine are provided along with other vaccines, free of cost under UIP at one and half month, two and half month, and three and half month of age of child.
- Rotavirus vaccine was introduced in 2016 in a phased manner, beginning with 4 states initially.
- Rotavirus vaccine is now available in 28 States/UTs.
- The vaccine is expected to be available in all 36 States/UTs by September 2019.

### **Suggested reading:**

1. **{Bio – Diseases – 19/07/19} Universal Immunisation Programme (UIP)**
2. **{Bio – Diseases – 19/07/19} UIP: Karnataka to introduce Rotavirus vaccine in UIP**

## **{Bio – Diseases – 19/08/01} Trial of new tuberculosis vaccines**

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[IE](#) | 01-08-2019 | [Biology](#) > [Disease](#) | [GS2](#) > Issues related to health

- Indian Council of Medical Research (ICMR) launched trial for two new tuberculosis (TB) vaccines.
- The incidence of TB was nearly 2.8 million and MDR TB was 1,47,000 per year, respectively.
- India contributes to 27 per cent of the global TB burden; the highest share globally.
- That is why, in 2017, the central government had committed itself to **eliminating TB by 2025**.
- The new vaccines that are being put through the trials offer a chance to contain the accelerating spread of multi-drug resistant TB.

- Treating TB requires a multi-drug course of treatment lasting **six months**; longer still for treating drug-resistant TB.
- Treatment failure and recurrence can have devastating consequences.

## Why new vaccines?

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- Scientists felt a critical need for new TB vaccines that are more effective than the **Bacille Calmette-Guerin (BCG) vaccine**.
- The BCG vaccine is used in the routine Expanded Programme of Immunisation (EPI) in countries across the world. It is generally given at birth or in the first year.
- The vaccine is over 100 years old and, while it has been partially effective in protecting infants and young children, it provides poor protection against pulmonary disease in adolescents and adults.
- It is for these reasons a need was felt to develop more effective preventive TB vaccines.

## Which vaccines?

- There are two vaccines being tested are **Immuvac (mycobacterium indicus pranii)** and **VPM1002**.
- Depending on the test results, the recommendations would be sent to the Ministry of Health.

## Tuberculosis (TB)

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- Tuberculosis (TB) is an infectious disease caused by **Mycobacterium tuberculosis**.
- Tuberculosis commonly affects the lungs but can also affect other parts of the body.
- It spreads from person to person through the air, when people who are infected with TB infection cough, sneeze or otherwise transmit respiratory fluids through the air.
- The most common risk factor associated with TB is **HIV** and other conditions that impair the immune system.
- Symptomatic Diagnosis: Coughing for more than 2 weeks, loss of weight, loss of appetite, fever and night sweats, fatigue are common symptoms of tuberculosis.

## Treatment

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- For new TB cases, the treatment in intensive phase (IP) consists of four drugs: **Isoniazid (INH), Rifampicin, Pyrazinamide and Ethambutol**.
- For previously treated cases of TB, the intensive phase is of 12 weeks, where injection **streptomycin** is given for eight weeks along with four drugs.
- **CBNAAT (Cartridges Based Nucleic Acid Amplification Test)** is used for early diagnosis of MDR-TB and TB in high risk population.

## **Multidrug-resistant TB (MDR-TB)**

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- The bacteria that cause TB can develop resistance to antimicrobial drugs used to cure the disease.
- Multidrug-resistant TB (MDR-TB) is TB that does not respond to at least **isoniazid** and **rifampicin**, the 2 most powerful anti-TB drugs.
- The 2 reasons why multidrug resistance continues to emerge, and spread are **mismanagement of TB treatment** and **person-to-person transmission**.
- Most people with TB are cured by a strictly followed 6-month drug regimen.
- Inappropriate or incorrect use of antimicrobial drugs or use of ineffective formulations of drugs and premature treatment interruption can cause drug resistance.
- In some countries, it is becoming increasingly difficult to treat MDR-TB.
- Treatment options are limited, and expensive.
- In some cases, even more severe drug-resistant TB may develop.
- **Extensively drug-resistant TB**, XDR-TB, is a form of multidrug-resistant TB with additional resistance to more anti-TB drugs.

## **{Bio – Diseases – 19/08/06} HIV treatment drug recommended by WHO**

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[The Hindu](#) | 06-08-2019 | General Science > Biology > Diseases > [HIV](#)

- Assessing benefits and risks, WHO has recommended the use of the HIV drug **dolutegravir (DTG)** as the preferred first-line and second-line treatment for all populations, including pregnant women.
- The risk of side effects like neural tube defects are significantly lower than what the initially thought.
- DTG is more effective, easier to take and has **fewer side effects than alternative drugs**.
- It also has a **high genetic barrier to developing drug resistance**.

## **AIDS – Acquired Immuno Deficiency Syndrome**

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- AIDS stands for **Acquired Immuno Deficiency Syndrome**.
- This means [deficiency of immune system](#), acquired during the lifetime of an individual.
- AIDS is caused by the Human Immuno Deficiency Virus (HIV), a member of a group of viruses called Retrovirus, which have an envelope enclosing the RNA genome.
- Transmission of HIV-infection generally occurs through **body fluids**.

More info: [pmfias.com/aids-acquired-immuno-deficiency-syndrome-human-immuno-deficiency-virus-hiv/](http://pmfias.com/aids-acquired-immuno-deficiency-syndrome-human-immuno-deficiency-virus-hiv/)

## **{Bio – Diseases – 19/08/16} New Tuberculosis Drug Pretomanid**

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- Worldwide, TB has surpassed HIV-AIDS as the leading cause of death due to infectious diseases.
- The incidence of TB was nearly 2.8 million and MDR TB was 1,47,000 per year, respectively.
- India contributes to 27% of the global TB burden; the highest share globally.
- As per WHO, an estimated 4.5 lakh people have MDR-TB and nearly 37,500 people have XDR-TB.
- Out of these, India has 24% of MDR-TB cases in the world.

## Tuberculosis (TB)

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- Tuberculosis (TB) is an infectious disease caused by **Mycobacterium tuberculosis**.
- TB commonly affects the **lungs (pulmonary TB)** but **can also affect other parts (extra pulmonary TB)**.
- It spreads from person to person through the air, when people who are infected with TB infection cough, sneeze or otherwise transmit respiratory fluids through the air.
- The most common risk factor associated with TB is **HIV** and other conditions that impair the immune system.
- Symptomatic Diagnosis: Coughing for more than 2 weeks, loss of weight, loss of appetite, fever and night sweats, fatigue are common symptoms of tuberculosis.

## TB Treatment

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- For previously treated cases of TB, the intensive phase is of 12 weeks, where injection **streptomycin** is given for eight weeks along with four drugs.
- Most people with TB are cured by a strictly followed 6-month drug regimen.

## Multidrug-resistant TB (MDR-TB)

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- **CBNAAT (Cartridges Based Nucleic Acid Amplification Test)** is used for early diagnosis of MDR-TB.
- In MDR-TB, the bacteria that cause TB develop resistance to antimicrobial drugs used to cure the disease.
- MDR-TB does not respond to at least **isoniazid** and **rifampicin**, the 2 most powerful anti-TB drugs.
- Treatment options for MDR-TB are limited, and expensive.
- In some cases, even more severe drug-resistant TB may develop.

## Extensively drug-resistant TB (XDR-TB)

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- XDR-TB is a form of multidrug-resistant TB with additional resistance to more anti-TB drugs.

- People who are resistant to isoniazid and rifampin, plus any fluoroquinolone and at least one of three injectable second-line drugs (amikacin, kanamycin, or capreomycin) are said to have XDR-TB.

## **Causes of multidrug resistant-TB**

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- Multidrug resistance is caused due to **mismanagement of treatment** and **person-to-person transmission**.
- Mismanagement of TB treatment involves inappropriate or incorrect use of antimicrobial drugs or use of ineffective formulations of drugs and premature treatment interruption.

## **Treatment for drug-resistant TB**

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- The treatment success in MDR-TB patients is about 54%, while it is just 30% in the case of XDR-TB patients.
- A combination of eight drugs for more than a year is need for XDR-TB treatment.
- Treatment success in XDR-TB patients depends on the extent of the drug resistance, the severity of the disease, whether the patient's immune system is weakened, and adherence to treatment.
- Drugs used for treating MDR-TB and XDR-TB can cause **serious adverse effects** such as deafness.

## **New Promising Drug Pretomanid**

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- Treating MDR-TB and XDR-TB could get simpler and shorter with the new drug **Pretomanid**.
- Pretomanid is only the third anti-TB drug approved by U.S. FDA in more than 40 years.
- The drug was developed and tested by New York-based non-profit organisation TB Alliance.

## **What makes Pretomanid promising?**

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- The duration of treatment for drug-resistant TB can be cut from **18-24 months** to just **six-nine months** when three-drug regimen consisting of **Bedaquiline, Pretomanid and Linezolid** (BPaL regimen) is used.
- The all-oral, three-drug regimen can vastly improve the treatment success rate & adherence to treatment.
- Importantly, the regimen was found to be safe and effective in curing TB in people living with HIV.
- Unlike bedaquiline, which is expensive, pretomanid might become affordable.

## **Which category of drug-resistant TB patients will benefit from this new drug?**

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- BPaL regimen is meant for treating adults with **XDR-TB**.
- In the case of MDR-TB, the three-drug regimen containing pretomanid can be used only in those patients who cannot tolerate the MDR-TB treatment or do not respond to standard MDR-TB treatment regimen.
- The three-drug regimen is meant **only for treating pulmonary TB** and should not be used for treating extra-pulmonary TB, drug-sensitive or latent TB.

## What are the adverse reactions caused by the drug?

- The three-drug regimen was reported to have caused adverse reactions including liver toxicity (hepatotoxicity), suppression of bone marrow leading to reduced production of red & white blood cells & platelets, etc.

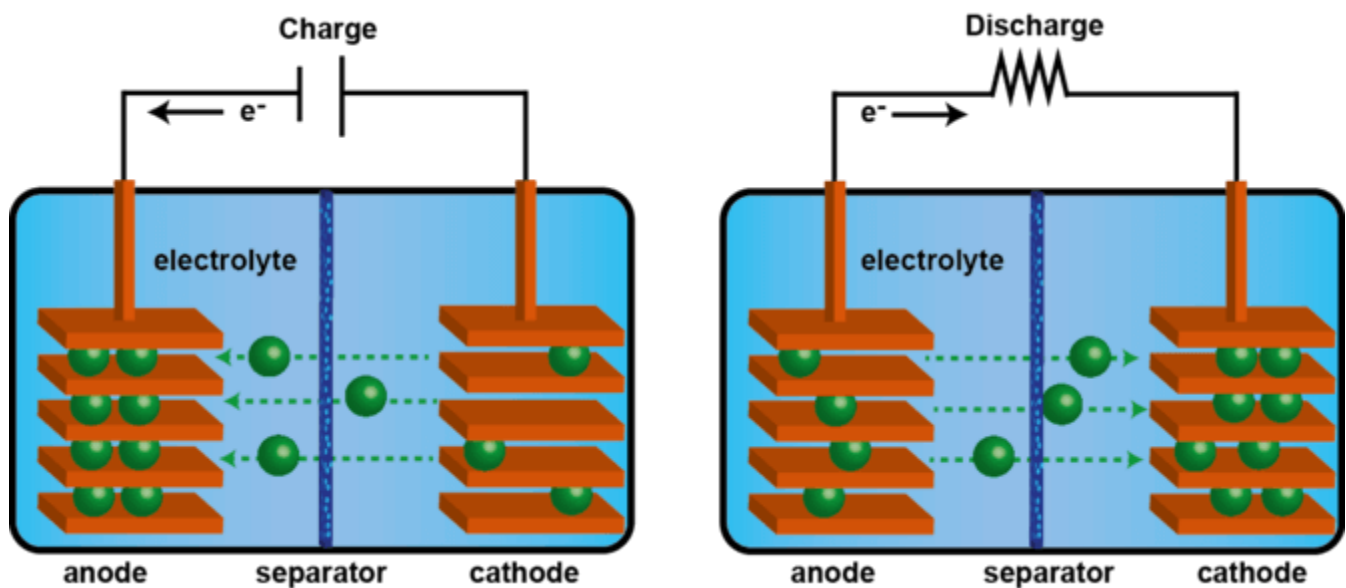
## {S&T – 19/08/10} Lithium ion battery, Lithium, Cobalt, EVs vs. ICEVs

[The Hindu](#) | 10-08-2019 | GS3 > Sci & Tech – developments and their applications and effects in everyday life

### Relevance

- IIT Madras researchers have fabricated a **rechargeable iron ion battery**.
- With increased focus on electric vehicles, it is essential to develop rechargeable batteries that are cheaper.
- With **no lithium reserves in India**, the stress is on developing rechargeable batteries of comparable performance using materials other than lithium.

## Lithium ion battery



Schematic of a rechargeable battery ([Image Credits](#))

- Anode, cathode, electrolyte and separator are the main components of a lithium ion (rechargeable) battery.
- The two electrodes are immersed in the electrolyte and are separated by the separator.
- The anode is usually made up of **graphite (carbon)**.
- Carbon graphite has a **layered structure** that can store the lithium ions in between its layers.
- The cathode is made up of a combination of **lithium-cobalt**.
- Lithium is unstable in the element form; hence the combination lithium-cobalt oxide is used for cathode.
- Cathode plays an important role in determining the energy density of a Li-ion battery.

- The higher amount of lithium, bigger the capacity.

### Working of a typical lithium ion battery

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- Both electrodes in a li-ion battery can **intercalate** or 'absorb' lithium ions.
- **When the battery is being charged, lithium ions are absorbed (stored) in the anode.**
- **During discharge, lithium ions naturally flow back to the cathode through the electrolyte.**
- This creates **free electrons** in the anode which move along the wire generating electricity.
- The process (to and fro movement of lithium ion) repeats with each charge and discharge cycles.

- **Charge Process:** Positive electrode (cathode) is oxidized (loses electrons) and  $\text{Li}^+$  ions pass across the electrolyte and are intercalated (insert between layers) in negative electrode (anode – graphite).
- **Discharge Process (opposite of charge process):** An oxidation reaction occurs at the anode (-ve),  $\text{Li}^+$  ions are de-intercalated and migrate across the electrolyte to be re-intercalated into the cathode material.

- **Electrolyte (lithium salt)** enables the movement of **lithium ions** between the electrodes.
- The **separator** functions as a physical barrier keeping cathode and anode apart.
- It **prevents the direct flow of electrons** and **lets only the ions pass through**.
- While the cathode determines the performance of a battery, electrolyte and separator determines its safety.
- **Permeable polymer membranes** such as polyethylene (PE) and polypropylene (PP) are used as separators.

### Why lithium?

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- Lithium is the **lightest metal** and a powerful **reducing agent** (willing to donate its electrons).
- Lithium ion batteries capitalize on the strong reducing potential of lithium ions to power the redox reaction — reduction at the cathode, oxidation at the anode.

### Iron ion battery developed by IIT Madras

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- $\text{Fe}^{2+}$  ions are the charge carriers in iron ion battery (in lithium ion battery **lithium ions** do the job).
- The iron ion battery uses **mild steel** as the anode and **Vanadium pentoxide** as cathode.
- The large inter-layer spacing in vanadium pentoxide makes intercalation easier (loss and gain of ions).
- In pure iron, intercalation is not possible. But, small amount of carbon in mild steel facilitates this process.
- Ether-based electrolyte containing dissolved iron perchlorate is used as electrolyte.
- The energy density of iron ion battery is 220 Wh/kg (**350 Wh/kg** in case of lithium ion battery).
- When compared with lithium metal-based batteries, iron ion batteries would be cheaper yet safer.



**Energy density** is measured in **watt-hours per kilogram (Wh/kg)** and is the amount of energy the battery can store with respect to its mass.

### How is iron better than lithium?

- The **redox potential** (potential to lose or gain electrons) of iron ion is higher than lithium ion.
- The radius of the Fe<sup>2+</sup> ion is nearly the same as that of the lithium ion.
- Iron is more stable during the charging process and therefore prevents short-circuiting of the batteries.
- When more iron ions bind to the cathode, more energy (higher energy density) can be stored in the battery.

### Comparison: Lead-acid battery, Lithium ion battery & Iron ion battery by IIT

<b>Comparison table</b>	<b>Lead-acid battery</b>	<b>Lithium ion battery</b>	<b>Iron ion battery by IIT</b>
Electrolyte	Sulphuric acid	<b>Lithium salt</b> (Lithium hexafluorophosphate)	Iron perchlorate
Anode	Lead	<b>Carbon (graphite)</b>	Mild Steel
Cathode	Lead dioxide	<b>Lithium-Cobalt Oxide (Lithium-Nickel-Manganese-Cobalt Oxide)</b>	Vanadium pentoxide
Applications	Inverters, automobile batteries, solar batteries	<b>Mobile, laptop, electric vehicle batteries</b>	-
Energy Density (Wh/kg)	30 to 40	<b>350</b>	220
Weight and Space	Heavy and occupies more space	<b>Comparatively lighter and occupies less space</b>	-
Lifecycle	Low (2-4 years)	<b>High (6-8 years)</b>	-
Maintenance	Yes	<b>No</b>	No
Reliability	Low (full discharge damages battery)	<b>High</b>	-
Initial cost	Low	<b>High</b>	-
Lifecycle cost	High	<b>Low</b>	-
Toxicity	<b>High</b>	<b>Low</b>	Low

### Lithium

Among twelve minerals identified as strategic minerals, **Lithium** and **Cobalt** are significant.

- Lithium is lightest known metal. It has a density of 0.534 g/cm<sup>3</sup> (half as dense as water).
- It's light and soft and has lowest melting points of all metals and a high boiling point.

- **Lithium-ion batteries** are key to **lightweight, rechargeable** power for laptops, phones, electric vehicles.
- **Lithium** and another battery component, **cobalt**, could become scarce as demand increases.
- China controls most of the lithium supply across the world.

World's Lithium Reserves in Million Tons			World's Lithium Production in Thousand Tons		
Country	Reserves		Country	Production	
<b>Chile</b>	<b>7.5</b>	<b>47%</b>	<b>Australia</b>	<b>18.7</b>	<b>43%</b>
<b>China</b>	<b>3.2</b>	<b>20%</b>	<b>Chile</b>	<b>14.1</b>	<b>33%</b>
<b>Australia</b>	<b>2.7</b>	<b>17%</b>	<b>Argentina</b>	<b>5.5</b>	<b>13%</b>
<b>Argentina</b>	<b>2</b>	<b>13%</b>	<b>China</b>	<b>3</b>	<b>7%</b>
World total	16 MT		World total	43 TT	

## Cobalt

- Cobalt is an important **ferromagnetic alloying metal** having irreplaceable industrial applications.
- Cobalt is extracted as a by-product of copper, nickel, zinc or precious metals.
- **Super alloys** made of cobalt are wear & corrosion-resistant at elevated temperatures.

### Role of cobalt in Lithium ion batteries

- **Lithium-cobalt-oxide** is used as **cathode in rechargeable batteries**.
- Lithium-cobalt-oxide is an intercalation compound with the lithium, cobalt and oxygen arranged in layers.
- Cobalt is indispensable to assure the **rate performance** (rate of charging & discharging occurs).
- When the lithium ion arrives or departs from cathode, cobalt changes its oxidation state (**compensates for the gain/loss of charge**) so that the **lithium-cobalt-oxide stays electrically neutral**.
- Cathodes are commonly oxides made from transition metals such as nickel, cobalt, copper, iron, etc.
- Replacing the costly cobalt with significantly cheaper nickel can be a fire hazard.
- **Aluminium & manganese** can be added to stabilize, but it lowers the capacity of the cell by a small amount.

### Distribution of Cobalt Reserves across India and the World

State	Reserves in MT		Region with reserves
<b>1. Odisha</b>	31	69%	<b>Kendujhar and Jajpur districts</b>
<b>2. Jharkhand</b>	9	20%	<b>Singhbhum district</b>
<b>3. Nagaland</b>	5	11%	<b>Tuensang district</b>
Total	44.9 MT		Presently, there is no production of cobalt from cobalt resources.

- India is aggressively pushing electric mobility. All electric vehicles at present use **Lithium ion batteries**.
  - Hence, India has to aggressively push to secure **lithium and cobalt (strategic minerals)** resources both internally and externally.
  - China has already taken a substantial lead in the race by aggressively procuring these minerals from **Congo**.
- The demand for cobalt is usually met through imports.
  - **Recycling technologies** for recovery of cobalt from **waste Li-ion batteries** have been an evolving process.
  - Imports of cobalt and alloys were at 875 tonnes in 2017-18.
  - Imports were mainly from **USA & Canada** (13% each), Belgium (12%), Norway & UK (9% each) and China (8%) & Morocco (7%).

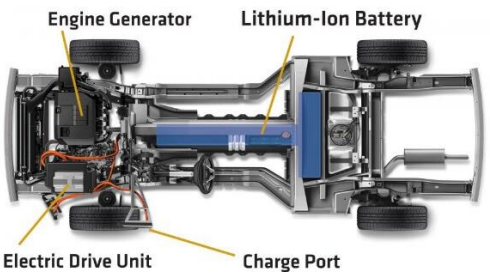
World's Reserves of Cobalt Content (in TT)			World's Production of Cobalt Content in 2017 (in TT)		
Country	Reserves		Country	Production	
<b>Congo (Kinshasa)</b>	<b>3400</b>	<b>49%</b>	<b>Congo</b>	<b>82.5</b>	<b>59%</b>
<b>Australia</b>	<b>1200</b>	<b>17%</b>	New Caledonia	9.4	7%
Cuba	500	7%	<b>China</b>	<b>9</b>	<b>6%</b>
World Total	6900 TT		Total	139 TT	

### Internal Combustion Engine Vehicles vs. Electric Vehicles

**Mains Practise: "The Internal Combustion Engine Is A Dead Man walking." Critically analyse this statement.**

**Mains Practise: "The age of the Internal Combustion Engine (ICE) is over. Electric cars are the future." Critically analyse this statement.**

#### EVs are a lot better than ICEVs

	Internal Combustion Engine Vehicles (ICEV)	Electric Vehicles (EV)	Winner
Major Components	IC engine, Transmission System.	DC/AC motor, digital controller, battery pack.  <p>Image Credits</p>	EV

Weight	Comparitively heavier.	Comparitively lighter.	EV
	Heavy due to large and heavy metallic engines with complicated design.	Motor engines are relatively lighter as they have fewer components and simplistic dsign.	EV
Space occupied by components	Comparitively more because of large engines.	Comparitively less → more space for seating → good for congested countries like India	EV
Efficiency	Less efficient because of loss of energy in the form of heat in IC engines and due to friction between transmission systems (rotatory motion has to be transmitted using a complex set of bearings and shafts).	More efficient as the loss of energy in the form of heat is very low (not many moving parts in motors) and transmission losses are minimum (the motor engine shaft transmits rotatory motion either directly to the wheels or with the help of fewer bearings and shafts).	EV
Maintainance	More maintainance (frequent, oil change, components replacement) is required as there are many moving parts.	Less maintainance as battery is the only major component to be replaced. (low recurring cost)	EV
Initial cost of development and owbership	Comparitively low as the technology is in place for a century now.	High as the technology is still evolving.	IC
Total lifecycle economic cost	High	Low (electricity cost associated with operating an EV over a distance of 1 km is significantly lower than the petrol/diesel cost required to operate a comparable IC vehicle)	EV
Acceleration and speed control	Comparitively less as there many states like ignition, four stages of IC engine, transmission, etc.	EVs are much faster as the transmission of power and rotatory motion are almost instantaneous.	EV
Environmental footprint	High	Comparatively low (EV are more efficient)	
Range	Once the tank is full ICEVs can travel non-stop for hundreds of kms	The range of EVs at present is only a few hundred kms.	IC
Fuelling	Done in a few minutes.	Charging batteries takes a few hours	IC
Infrastructure	Filling stations, and other infrastructure is in place.	Charging stations are slowly popping up.	IC
Resale value	Resale value is falling as EVs are the future	Better	EV

Import-substitution.	Heavy dependence on imported fuels.	Clean electricity can replace fossil fuels. India now generates 22% (79 GW) of its electricity from renewable sources alone.	EV
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Share of major fuels in Power Generation in India			
Total Installed Capacity (As on 31.05.2019)			
Fuel		Giga Watt	% share
Thermal	Total Thermal	226.3	63.2%
	Coal	194.5	54.3%
	Lignite	6.3	1.7%
	Gas	24.9	7.0%
	Oil	0.64	0.2%
Hydro (Renewable)		45.4	12.7%
Nuclear		6.8	1.9%
Renewable		79.3	22.0%
Total		357.9	

### Demand for EVs is rising rapidly

#### Electric car battery life is increasing

- One major factor that turned into a bottleneck in adopting EVs is the battery life.
- At present lithium ion batteries in EVs have a lifecycle of 6-8 years which is decent.
- With improving technologies, this is only set to go up.

#### Battery capacity is increasing, and prices are falling

- Lithium-Ion batteries are increasing in energy density at a rate of 5-8% per annum.
- Battery Costs are falling: The main cost of an electric vehicle is the cost of the battery. Lithium-Ion batteries cost \$1,000 per kWh in 2010. By 2017 that cost had fallen to \$200 per kWh, and it won't stop there.

#### Favourable policy

- China and India are aggressively pushing for electric mobility with a slew of measures.
- India reduced GST on EVs from 12% to 5%. Introduced schemes like FAME, FAME II.

### {S&T – Space – 19/08/14} Why it took Chandrayaan-2 29 days to reach moon's orbit?

- Chandrayaan-2's primary goal is to reach the moon at a least possible expense (Rs 978 crore).
- Moreover, Chandrayaan-2 is not a manned mission and hence duration was not such a critical factor.
- And also, **India doesn't have a rocket powerful enough** to place Chandrayaan-2 in a straight path to the moon to shorten the journey.
- ISRO used [GSLV MkIII](#) rocket to put Chandrayaan-2 in [geosynchronous transfer orbit](#).
- Chandrayaan-2 payload is 3.8 tonnes and the payload capacity of [GSLV MkIII to geosynchronous transfer orbit is only 4 tonnes](#).

## How did Chandrayaan-2 reach moon's orbit from geosynchronous transfer orbit?

*The below explanation is general in nature and may not be scientifically very accurate.*

- Being a small engine, the craft's engine is not fired continuously but in short bursts.
- Each burst was used to push the rocket to a higher orbit and attain greater velocity.
- The craft needed **no additional energy to remain in the orbit as earth's gravitational pull held it in place**.
- Five such orbit-raising manoeuvres were used to attain an apogee that is closer to the moon's orbit.
- So, **instead of going against earth's gravity (straight to moon)**, which requires a very powerful rocket and a lot of fuel, Chandrayaan-2 lunarcraft used earth's gravity assist to reach the [Lunar Transfer Trajectory](#).

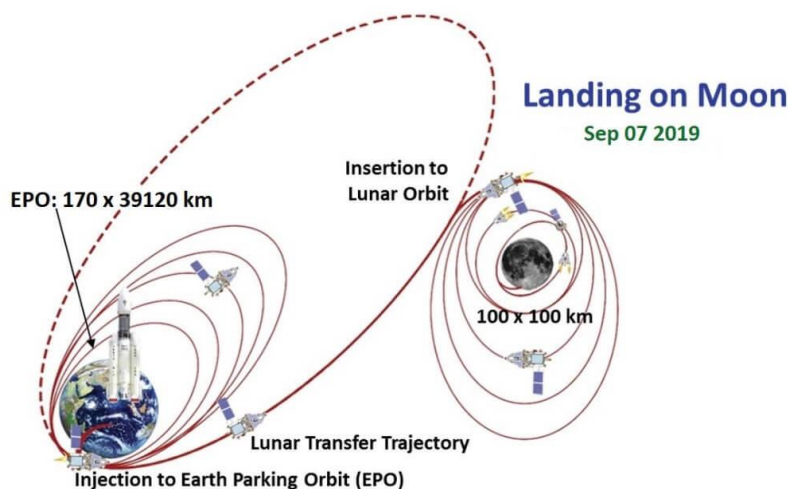


Image Credits: ISRO

- From [Lunar Transfer Trajectory](#), the lunarcraft is now heading for its next orbit, which will be around the Moon.
- On approaching the lunar orbit, the liquid engine will be fired again to insert the lunarcraft into a lunar orbit.

- Following this, there will be further four orbit manoeuvres to take the spacecraft into its final orbit, passing over the lunar poles at a distance of about 100 km from the Moon's surface.

## How did US manage to reach moon in a short duration?

- Nasa's 1969 Apollo-11 mission carrying humans landed on Moon in just four days.
- In space, covering long distances in short duration requires **high speeds and straight trajectories**.

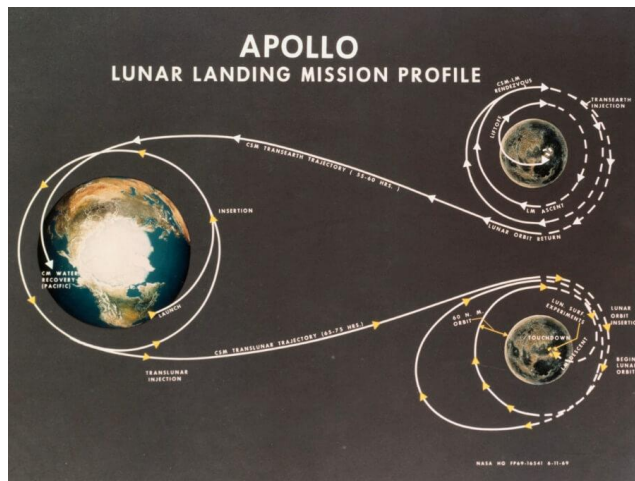


Image Credits: [History.com](https://www.history.com)

- Rockets moving in straight trajectories **act against gravity throughout**.
- Hence, they need to be **very powerful to overcome earth's gravitational pull**.
- Also, the rocket's engines need to be fired quite often which means they **need to carry a lot of fuel**.
- For Apollo-11, Nasa had used Saturn V, a super heavy-lift launcher that travelled at more than 39,000 kmph.
- The powerful rocket had a lifting capability of 43 tonnes.
- Nasa had to pump in \$185 million (\$1.2 billion in 2016 value) for the mission.
- Of the \$185 million, NASA spent \$110m (\$690m in 2016 value) on building Saturn V alone.
- India does not have a rocket powerful enough to hurl Chandrayaan-2 on a straight path to Moon.
- Hence, ISRO **had to take advantage of Earth's gravity (gravity helped slingshot the craft towards the Moon)** instead of using a powerful rocket to reach moon.
- **Israel's Beresheet mission** launched early this year also used the same **cost-effective route to Moon**.

**Basics:** <https://www.pmfias.com/keplers-laws-satellite-orbits-pslv-gslv/>

**Must Read:** {S&T – Space – 10/07/14} *Chandrayaan-2: India's second lunar mission*

**Science and Technology topics in the pipeline (pending since June. Will be uploading them gradually once the Pending Work on Economic Geography and Indian Agriculture is completed)**

- Internet of Things, Artificial Intelligence.
- Blockchain Technology, Bitcoin, Ethereum, **Facebook's Libra**
- QLED, OLED, etc. (Samsung launched QLED TVs recently)
- ICT technologies: 2G, 3G, 4G LTE vs. 4G VoLTE, 5G

**{Sci – Bio – 19/08/22} In News**

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[IE](#) | 22-08-2019

**Oxytocin**

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- Oxytocin, also known as the '**love hormone**', is a hormone secreted by the **pituitary glands** of mammals **during sex, childbirth, lactation or social bonding**.
- However, it can also be chemically manufactured and is sold by pharma companies for use during childbirth.
- Oxytocin helps contract the uterus (induce delivery), control bleeding, and promote the release of breast milk.
- It is crucial to prevent mothers from excessive bleeding after giving birth (major cause of maternal deaths).

**Why in news?**

- The health ministry in 2018 notified a ban on private firms from manufacturing and selling oxytocin, stating that it wanted to restrict the responsibility to a PSU to avoid its misuse in the veterinary field.
- Delhi High Court in December quashed the ban on various grounds, including that it lacked scientific basis.