



## ISRO's Launch Vehicles

**For Prelims:** Launch Vehicles, Satellites.

**For Mains:** Space Technology.

### Why in News?

Recently, the [Indian Space Research Organization \(ISRO\)](#) launched an [Earth Observation Satellite \(EOS-04\)](#) along with two other smaller satellites into space using a **PSLV (Polar Satellite Launch Vehicle) rocket**. This was the 54<sup>th</sup> flight of the PSLV rocket.

### What are Launch Vehicles and Satellites?

- The **rockets have powerful propulsion systems that generate the huge amount of energy required to lift heavy objects like satellites** into space, overcoming the gravitational pull of the earth.
- **Satellites** carry one or more instruments that do the scientific work for which they are sent into space. Their **operational life sometimes extends up to decades**.
  - But **rockets, or launch vehicles, become useless after the launch**. Rockets' only job is to take the satellites to their intended orbits.
- **Rockets have several detachable energy-providing parts**.
  - They burn different kinds of fuels to power the rocket. Once their fuel is exhausted, they detach from the rocket and fall off, often burning off in the atmosphere due to air-friction, and getting destroyed.
  - Only a small part of the original rocket goes till the intended destination of the satellite. Once the satellite is finally ejected, **this last part of the rocket either becomes part of space debris, or once again burns off after falling into the atmosphere**.

### What are the Types of Launch Vehicles?

- **For Lower Earth Orbits:**
  - Several satellites need to be deposited only in the **lower earth orbits, which starts from about 180 km from earth's surface and extends up to 2,000 km**.
    - Most of the earth-observation satellites, communication satellites, and even the [International Space Station](#), a full-fledged laboratory in space that hosts astronauts, function in this space.
  - It takes a smaller amount of energy to take the satellites to low-earth orbits, and accordingly smaller, **less powerful, rockets are used for this purpose**.
- **For Higher Orbits:**
  - There are other satellites which need to go much deeper in space.
  - Geostationary satellites, for example, have to be deposited in orbits that are about 36,000 km from earth's surface.
  - The planetary exploration missions also need their rockets to leave them much deeper in space.

- For such space missions, **much more powerful rockets are used.**
  - In general, there is a **trade-off between the weight of the satellite that needs to be launched, and the distance it needs to be taken to.** The same rocket can take smaller satellites much deeper into space compared to a heavier satellite.

### What are the Launch vehicles used by ISRO?

<b>Satellite Launch Vehicle (SLV):</b>	<ul style="list-style-type: none"> <li>▪ The first rocket developed by ISRO was simply called <b>SLV, or Satellite Launch Vehicle</b>.</li> <li>▪ It was followed by the <b>Augmented Satellite Launch Vehicle or ASLV.</b></li> </ul>
<b>Augmented Satellite Launch Vehicle (ASLV):</b>	<ul style="list-style-type: none"> <li>▪ SLV and ASLV both could carry small satellites, <b>weighing up to 150 kg</b>, to lower earth orbits.</li> <li>▪ ASLV operated till the early <b>1990s before PSLV</b> came on the scene.</li> </ul>
<b>Polar Satellite Launch Vehicle (PSLV):</b>	<ul style="list-style-type: none"> <li>▪ PSLV's first launch was in 1994, and it has been ISRO's main rocket ever since. Today it is <b>several times more powerful than the ones</b> used in the 1990s. <ul style="list-style-type: none"> <li>◦ It is the first Indian launch vehicle to be equipped with liquid stages.</li> </ul> </li> <li>▪ PSLV is the <b>most reliable rocket used by ISRO till date</b>, with 52 of its 54 flights being successful. <ul style="list-style-type: none"> <li>◦ It successfully launched two spacecraft - <b>Chandrayaan-1</b> in 2008 and <b>Mars Orbiter Mission</b> in 2013. Chandrayaan-1 later traveled to Moon and Mars respectively.</li> <li>◦ ISRO <b>currently uses two launch vehicles - PSLV and GSLV</b> (Geosynchronous Launch Vehicle). There are lots of different variants of these.</li> </ul> </li> </ul>
<b>Geosynchronous Satellite Launch Vehicle (GSLV):</b>	<ul style="list-style-type: none"> <li>▪ GSLV is a much <b>more powerful rocket</b>, meant to carry <b>heavier satellites much deeper into space</b>. It has carried out 18 missions, of which <b>four ended in failure.</b></li> <li>▪ It <b>can take 10,000-kg satellites</b> to lower earth orbits.</li> <li>▪ The indigenously developed <b>Cryogenic Upper Stage (CUS)</b>, forms the third stage of the rocket.</li> <li>▪ Mk-III versions have made ISRO entirely <b>self-sufficient for launching its satellites</b> to geosynchronous orbit. <ul style="list-style-type: none"> <li>◦ Before this, it used to depend on the European Ariane launch vehicle to take satellites to geosynchronous orbit.</li> </ul> </li> </ul>
<b>Small Satellite Launch Vehicle (SSLV):</b>	<ul style="list-style-type: none"> <li>▪ SSLV is targeted at rising global demand for the launch of small and micro-satellites.</li> <li>▪ SSLV is meant to offer <b>cost-effective launch services for satellites up to 500 kg</b> to low earth orbit.</li> <li>▪ It is supposed to carry an indigenous earth observation satellite EOS-03 into space.</li> </ul>
<b>Reusable Rockets/ Future Rockets:</b>	<ul style="list-style-type: none"> <li>▪ The future rockets are meant to be reusable. Only a small part of the rocket would be reusable.</li> <li>▪ The bulk of it would <b>re-enter the earth's atmosphere and land very much like a plane</b> after each mission.</li> <li>▪ Reusable rockets would <b>cut down on costs and energy</b>, and also reduce space debris problem because of the large number of launches.</li> <li>▪ <b>Fully-reusable rockets are still to be developed</b>, but partially-reusable launch vehicles are being developed.</li> <li>▪ ISRO has <b>also developed a reusable rocket, called RLV-TD (Reusable Launch Vehicle-Technology Demonstrator)</b> which has had a successful test flight in 2016.</li> </ul>

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