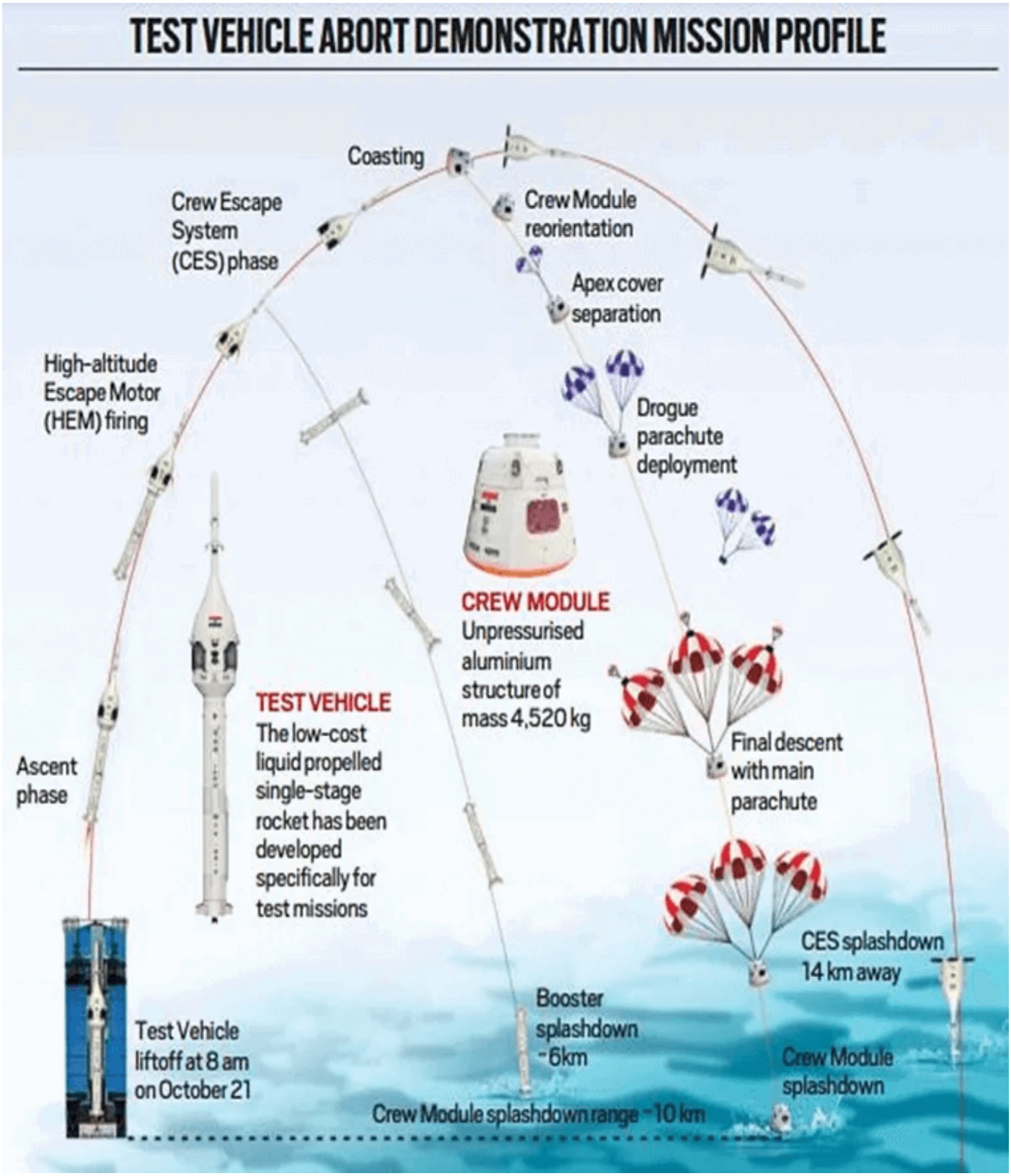
GAGANYAAN - SPACE

ISRO successfully carried out an Integrated Air Drop Test simulating the re-entry, parachute deployment, and sea recovery of the Gaganyaan crew module, marking a key milestone for India's first human spaceflight mission.Parachute System: Designed by DRDO; part of a 10-parachute configuration for actual flights.



Integrated Air Drop Test (IADT-01)

Aim - Evaluate the complete parachute deployment sequence for crew safety, covering:

1. Extraction of the crew module from the carrier system.
2. Activation of the drogue parachute for initial deceleration.
3. Deployment of the main parachute for final descent.

Methodology

1. A dummy crew capsule weighing approximately 5 tonnes is used.
2. The capsule is dropped from an Indian Air Force Chinook helicopter to simulate real deployment conditions.
3. The test validates performance of deceleration, stability, and landing systems under operational conditions.

Re-entry Test Mission

Purpose - Demonstrates that a spacecraft can safely return to Earth from orbit.

Key Objectives

1. Survive extreme heat and aerodynamic stresses during hypersonic atmospheric re-entry.
2. Reliably deploy deceleration systems, like drogue and main parachutes, to ensure controlled descent.
3. Ensure safe recovery, either via splashdown in water or soft landing on land, validating retrieval procedures.

Gaganyaan Mission Overview

Significance - Flagship human spaceflight program of ISRO aimed at demonstrating India's ability to send humans to space and return them safely.

Primary Goal - Send a crew to low Earth orbit (approximately 400 km) and ensure safe return.

Objectives -

1. Validate India's human spaceflight capability.
2. Inspire scientific and technological interest among Indian youth.
3. Strengthen India's position in global space technology and exploration.

Launch Vehicle & Technology

Vehicle - GSLV Mk III (also called LVM-3), modified for human-rating to ensure crew safety.

Propulsion - Three-stage rocket: solid, liquid, and cryogenic stages.

Safety Features - Equipped with a Crew Escape System (CES) for emergency evacuation. Orbital Module designed with redundancy and robust avionics to enhance safety.

Astronaut Training

Location - Selected astronauts are trained in Russia.

Training Includes -

1. Preparation for weightlessness and microgravity conditions.
2. Operation of spacecraft systems in simulated orbital environments.
3. Emergency response drills and survival training.

Integral Components of Gaganyaan Spacecraft

Orbital Module (OM) - Orbits Earth and comprises the Crew Module (CM) and Service Module (SM).Advanced avionics and redundant systems ensure operational reliability.

Crew Module (CM) - Habitable environment with Earth-like atmosphere for astronauts. Contains control systems, navigation, guidance, communication, avionics, and life support. Constructed with a double-wall rigid structure: a pressurized inner metallic shell and an unpressurized outer shell with Thermal Protection System (TPS). Designed for safe re-entry, deceleration, and landing.

Service Module (SM) - Provides orbital support including propulsion, power, thermal control, avionics, and deployment systems. Unpressurized structure supporting the Crew Module during flight.

Crew Escape System (CES)

Purpose - Ensures astronaut safety during emergencies.

Validation - Tested via Flight Test Vehicle Abort Mission-1 (TV-D1) to verify capability of separating Crew Module from the rocket in mid-flight.

Phases of the Gaganyaan Mission

Test Phase - Ensures system reliability before crewed missions. Includes:

1. **Integrated AirDrop Test (IADT) -** Validates parachute and deceleration systems.
2. **Pad Abort Test (PAT) -** Tests the CES by dropping the Crew Module from varying heights.
3. **Test Vehicle (TV) Flights -** Single-stage liquid rockets used to evaluate abort and emergency systems.
4. **Unmanned Missions**

1. Preceding human flight to test spacecraft systems and safety.
2. Includes airdrop tests, abort system validation, and flight trials.
3. Water Survival Test Facility (WSTF) assists initial recovery tests with Indian Navy support.

5. **Vyommitra:** A humanoid robot flying on unmanned missions to validate conditions for human astronauts.
6. **Manned Mission**

   Final phase where Indian astronauts are launched into orbit after successful unmanned tests.

Source: https://www.thehindu.com/sci-tech/science/isro-completes-first-integrated-air-drop-test-for-gaganyaan/article69971528.ece