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How are enumerators being trained for Census 2027?

What are the new questions? What are enumerators being told to ask about Aadhaar and caste?

GS I: Society

Vijaita Singh

The story so far:

Before door-to-door enumeration for the second phase of the Census begins in Uttar Pradesh and three other poll-bound States of Uttarakhand, Goa, and Punjab on December 1, ahead of the rest of the country in January 2027, field trainers are preparing enumerators for the challenging task ahead. The second phase of the Census, the Population Enumeration, will ask 40 questions, and the enumerators need to spend at least 20-25 minutes with each respondent.

Why is training important?

Door-to-door enumeration for the Census will involve 34 lakh enumerators, mostly government school teachers. However, on October 16, the government expanded the definition of "any person" who could be appointed as Census enumerators, authorising the appointment of private school teachers and members of "institutions, societies and trusts."

On September 9, Mritunjay Kumar Narayan, Registrar General of India and Census Commissioner, wrote to all States and Directors of Census Operations that Census is not merely an administrative and statistical exercise but is one of the empirical foundations for building Viksit Bharat. "Training is therefore not just a preparatory step; it is in itself a contribution to the national vision in producing quality data," it said.

As this is the first digital census, enumerators will record the data through an app on their phones.

"To improve interactions with households, the government introduced a framework called PRAMAN, comprising Pehchaan (Identity), Rishta (Rapport), Anurodh (Request), Madad (Assistance), Aankada Shuddhata (Data Accuracy), and Nishtha (Commitment). The framework will be embedded across all levels of training and reinforced through a Seva Bhav pledge administered to enumerators and supervisors," the circular said.

What is the training pyramid's structure?

Subject matter experts are appointed as National Trainers, who in turn train Master Trainers. Master Trainers train Field Trainers, who then impart training to enumerators and supervisors, ideally in batches of 35-50. The September 9 letter stated that hands-on practice with the Population Enumeration mobile app is mandatory for all.

Why are enumerators being asked to be sensitive?

In the September 9 circular, Mr. Kumar said that while Phase I training had established a digitally proficient Census workforce, Population Enumeration would require officials to engage with respondents on a wider range of sensitive issues, including religion, language, caste, disability, migration, economic activity and fertility.

Training modules will cover caste, fertility and religion-related questions. According to the circular, the quality, completeness and integrity of Census data will depend directly on the effectiveness of training provided to Census personnel.

The circular said Population Enumeration will require enumerators to ask questions relating to religion, mother tongue, Scheduled Caste and Scheduled Tribe status, caste, disability, migration, fertility and economic activity, among other subjects. It instructed trainers to place special emphasis on these categories and on the correct application of coding and probing techniques.

What are the peculiar questions asked?

On August 14, the RG & CCI notified a set of 40 questions to be asked during the Population Enumeration phase, or the second phase of the Census, adding 13 new questions or data fields that were not part of the Census 2011 questionnaire. Some of the additional questions – such as particulars of mother and father, including their names, religion and place of birth; Aadhaar, mobile, voter ID and driving license details – mirror those asked in the rehearsal form of the National Population Register in 2019.

What are field trainers telling the enumerators?

At a training session in Uttar Pradesh, a field trainer explained the importance of Question number 37, which seeks the respondent's Aadhaar number, if available. The trainer told the enumerators that if a respondent is hesitant, they should nudge and convince them that Aadhaar cannot be used for any other purpose without biometric authentication of the user, and that the information provided during the Census is confidential.

"If any respondent raises an issue, they should be told that the question is intended only to determine how many people possess an Aadhaar card. If we get the accurate information during the Census, then in the future this document may act as proof of citizenship," the trainer said.

A senior Census official, however, told *The Hindu* that "no such instructions" have been passed to the trainers. "There is no instruction to link Aadhaar with the citizenship test. The question is optional; if a person says that he or she has or does not have Aadhaar, it will be recorded as such," the Census official said.

Another question where the enumerators were told to be cautious was question number 10C, which asks for the caste of the respondent. "You have to manually write the caste, as you are being told; there will be no drop-down box with options. It is a sensitive question, and your job is not to argue or provide any commentary on the issue," the field trainer told the enumerators. "There will be no separate column for OBCs (Other Backward Classes)," he added.

Other than Scheduled Caste and Scheduled Tribes, who can choose the names from a predetermined drop-down box, all others will have to type the caste name in an open column. This is Independent India's first caste enumeration. Question number 10 (C) says: "If not SC/ST in this State/U.T.,-Enter Caste name." There are two other options besides the Caste column – "Does not want to declare Caste" and "No Caste." The data fields are marked "mandatory".

03N11. How are enumerators being trained for Census 2027?
जनगणना 2027 के लिए प्रगणकों को प्रशिक्षण कैसे दिया जा रहा है?

- Before door-to-door enumeration for the second phase of the Census begins in Uttar Pradesh and three other poll-bound States of Uttarakhand, Goa, and Punjab on December 1, ahead of the rest of the country in January 2027, field trainers are preparing enumerators for the challenging task ahead.
  दिसंबर 1 को उत्तर प्रदेश और चुनाव वाले तीन अन्य राज्यों—उत्तराखंड, गोवा और पंजाब—में जनगणना के दूसरे चरण की घर-घर गणना शुरू होगी। देश के बाकी हिस्सों में यह जनवरी 2027 में शुरू होगी। इससे पहले, फील्ड ट्रेनर इस चुनौतीपूर्ण काम के लिए प्रगणकों को तैयार कर रहे हैं।
- The second phase of the Census, the **Population Enumeration**, will ask 40 questions, and the enumerators need to spend at least 20-25 minutes with each respondent.
  जनगणना के दूसरे चरण, **जनसंख्या गणना**, में 40 प्रश्न पूछे जाएँगे और प्रगणकों को प्रत्येक उत्तरदाता के साथ कम-से-कम 20–25 मिनट बिताने होंगे।

Why is training important?
प्रशिक्षण क्यों महत्त्वपूर्ण है?

- Door-to-door enumeration for the Census will involve 34 lakh enumerators, mostly government school teachers.
  जनगणना के लिए घर-घर जाकर गणना करने के काम में 34 लाख प्रगणक शामिल होंगे, जिनमें अधिकतर सरकारी स्कूलों के शिक्षक होंगे।
- However, on October 16, the government expanded the definition of "any person" who could be appointed as Census enumerators, authorising the appointment of private school teachers and members of "institutions, societies and trusts."
  हालाँकि, 16 अक्टूबर को सरकार ने जनगणना प्रगणक के रूप में नियुक्त किए जा सकने वाले "किसी भी व्यक्ति" की परिभाषा का दायरा बढ़ाया और निजी स्कूलों के शिक्षकों तथा "संस्थाओं, समितियों और न्यासों" के सदस्यों की नियुक्ति को अधिकृत किया।
- On September 9, Mritunjay Kumar Narayan, Registrar General of India and Census Commissioner, wrote to all States and Directors of Census Operations that Census is not merely an administrative and statistical exercise but is one of the empirical foundations for building **Viksit Bharat**.
  9 सितंबर को भारत के महापंजीयक और जनगणना आयुक्त मृत्युंजय कुमार नारायण ने सभी राज्यों और

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जनगणना संचालन निदेशकों को लिखा कि जनगणना केवल प्रशासनिक और सांख्यिकीय कवायद नहीं है, बल्कि **विकसित भारत** के निर्माण के लिए अनुभवजन्य आधारों में से एक है।

- "Training is therefore not just a preparatory step; it is in itself a contribution to the national vision in producing quality data," it said.
  पत्र में कहा गया, "इसलिए प्रशिक्षण केवल तैयारी का एक चरण नहीं है; गुणवत्तापूर्ण आँकड़े तैयार करने में यह अपने आप में राष्ट्रीय दृष्टि में योगदान है।"
- As this is the first **digital census**, enumerators will record the data through an app on their phones.
  यह पहली **डिजिटल जनगणना** है, इसलिए प्रगणक अपने फोन पर एक ऐप के माध्यम से आँकड़े दर्ज करेंगे।
- "To improve interactions with households, the government introduced a framework called **PRAMAN**, comprising Pehchaan (Identity), Rishta (Rapport), Anurodh (Request), Madad (Assistance), Aankada Shuddhata (Data Accuracy), and Nishtha (Commitment).
  "परिवारों के साथ संवाद बेहतर बनाने के लिए सरकार ने **PRAMAN** नाम का एक ढाँचा शुरू किया है। इसमें पहचान, रिश्ता, अनुरोध, मदद, आँकड़ा शुद्धता और निष्ठा शामिल हैं।
- The framework will be embedded across all levels of training and reinforced through a Seva Bhav pledge administered to enumerators and supervisors," the circular said.
  परिपत्र में कहा गया कि इस ढाँचे को प्रशिक्षण के सभी स्तरों में शामिल किया जाएगा और प्रगणकों तथा पर्यवेक्षकों को दिलाई जाने वाली सेवा-भाव प्रतिज्ञा के माध्यम से इसे मज़बूत किया जाएगा।"

What is the training pyramid's structure?
प्रशिक्षण की सोपान-व्यवस्था कैसी है?

- Subject matter experts are appointed as National Trainers, who in turn train Master Trainers.
  विषय विशेषज्ञों को राष्ट्रीय प्रशिक्षक नियुक्त किया जाता है, जो आगे मास्टर ट्रेनरों को प्रशिक्षण देते हैं।
- Master Trainers train Field Trainers, who then impart training to enumerators and supervisors, ideally in batches of 35-50.
  मास्टर ट्रेनर फील्ड ट्रेनरों को प्रशिक्षित करते हैं, जो फिर आदर्श रूप से 35–50 लोगों के समूहों में प्रगणकों और पर्यवेक्षकों को प्रशिक्षण देते हैं।
- The September 9 letter stated that hands-on practice with the **Population Enumeration mobile app** is mandatory for all.
  9 सितंबर के पत्र में कहा गया कि सभी के लिए **जनसंख्या गणना मोबाइल ऐप** पर व्यावहारिक अभ्यास करना अनिवार्य है।

Why are enumerators being asked to be sensitive?
प्रगणकों से संवेदनशीलता बरतने को क्यों कहा जा रहा है?

- In the September 9 circular, Mr. Kumar said that while Phase I training had established a digitally proficient Census workforce, Population Enumeration would require officials to engage with respondents on a wider range of sensitive issues, including religion, language, caste, disability, migration, economic activity and fertility.
  9 सितंबर के परिपत्र में श्री कुमार ने कहा कि पहले चरण के प्रशिक्षण से डिजिटल रूप से दक्ष जनगणना कार्यबल तैयार हुआ है, लेकिन जनसंख्या गणना के दौरान अधिकारियों को धर्म, भाषा, जाति, दिव्यांगता, प्रवासन, आर्थिक गतिविधि और प्रजनन क्षमता सहित कई संवेदनशील विषयों पर उत्तरदाताओं से बातचीत करनी होगी।
- Training modules will cover caste, fertility and religion-related questions.
  प्रशिक्षण मॉड्यूल में जाति, प्रजनन क्षमता और धर्म से जुड़े प्रश्न शामिल होंगे।
- According to the circular, the quality, completeness and integrity of Census data will depend directly on the effectiveness of training provided to Census personnel.

परिपत्र के अनुसार, जनगणना के आँकड़ों की गुणवत्ता, पूर्णता और विश्वसनीयता सीधे तौर पर जनगणना कर्मियों को दिए गए प्रशिक्षण की प्रभावशीलता पर निर्भर करेगी।

- The circular said Population Enumeration will require enumerators to ask questions relating to religion, mother tongue, Scheduled Caste and Scheduled Tribe status, caste, disability, migration, fertility and economic activity, among other subjects.
  परिपत्र में कहा गया कि जनसंख्या गणना के दौरान प्रगणकों को धर्म, मातृभाषा, अनुसूचित जाति और अनुसूचित जनजाति की स्थिति, जाति, दिव्यांगता, प्रवासन, प्रजनन क्षमता और आर्थिक गतिविधि सहित अन्य विषयों से जुड़े प्रश्न पूछने होंगे।
- It instructed trainers to place special emphasis on these categories and on the correct application of coding and probing techniques.
  इसमें प्रशिक्षकों को इन श्रेणियों तथा कोडिंग और आगे पूछताछ की तकनीकों के सही इस्तेमाल पर विशेष ज़ोर देने का निर्देश दिया गया।

What are the peculiar questions asked?
कौन-से विशेष प्रश्न पूछे जा रहे हैं?

- On August 14, the RG & CCI notified a set of 40 questions to be asked during the Population Enumeration phase, or the second phase of the Census, adding 13 new questions or data fields that were not part of the Census 2011 questionnaire.
  14 अगस्त को महापंजीयक एवं जनगणना आयुक्त (RG & CCI) ने जनसंख्या गणना चरण—यानी जनगणना के दूसरे चरण—में पूछे जाने वाले 40 प्रश्नों की सूची अधिसूचित की। इसमें 13 नए प्रश्न या डेटा फ़ील्ड जोड़े गए, जो जनगणना 2011 की प्रश्नावली का हिस्सा नहीं थे।
- Some of the additional questions — such as particulars of mother and father, including their names, religion and place of birth; Aadhaar, mobile, voter ID and driving licence details — mirror those asked in the rehearsal form of the **National Population Register** in 2019.
  कुछ अतिरिक्त प्रश्न—जैसे माता और पिता का विवरण, जिसमें उनके नाम, धर्म और जन्मस्थान शामिल हैं; तथा आधार, मोबाइल, मतदाता पहचान-पत्र और ड्राइविंग लाइसेंस का विवरण—2019 में **राष्ट्रीय जनसंख्या रजिस्टर** के पूर्वाभ्यास फ़ॉर्म में पूछे गए प्रश्नों से मिलते-जुलते हैं।

What are field trainers telling the enumerators?
फील्ड ट्रेनर प्रगणकों को क्या बता रहे हैं?

- At a training session in Uttar Pradesh, a field trainer explained the importance of Question number 37, which seeks the respondent's Aadhaar number, if available.
  उत्तर प्रदेश में एक प्रशिक्षण सत्र के दौरान, एक फील्ड ट्रेनर ने प्रश्न संख्या 37 का महत्व समझाया, जिसमें उत्तरदाता से उपलब्ध होने पर उसका आधार नंबर पूछा जाता है।
- The trainer told the enumerators that if a respondent is hesitant, they should nudge and convince them that Aadhaar cannot be used for any other purpose without biometric authentication of the user, and that the information provided during the Census is confidential.
  ट्रेनर ने प्रगणकों से कहा कि यदि कोई उत्तरदाता झिझके, तो वे उसे समझाएँ और भरोसा दिलाएँ कि उपयोगकर्ता के बायोमेट्रिक प्रमाणीकरण के बिना आधार का किसी अन्य उद्देश्य के लिए इस्तेमाल नहीं किया जा सकता और जनगणना के दौरान दी गई जानकारी गोपनीय रहती है।
- "If any respondent raises an issue, they should be told that the question is intended only to determine how many people possess an Aadhaar card.
  "यदि कोई उत्तरदाता कोई चिंता जताए, तो उसे बताया जाना चाहिए कि इस प्रश्न का उद्देश्य केवल यह जानना है कि कितने लोगों के पास आधार कार्ड है।
- If we get the accurate information during the Census, then in the future this document may act as proof of citizenship," the trainer said.

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यदि जनगणना के दौरान हमें सटीक जानकारी मिलती है, तो भविष्य में यह दस्तावेज़ नागरिकता के प्रमाण के रूप में काम आ सकता है," ट्रेनर ने कहा।

- A senior Census official, however, told *The Hindu* that "no such instructions" have been passed to the trainers.
  हालाँकि, जनगणना विभाग के एक वरिष्ठ अधिकारी ने *द हिंदू* को बताया कि ट्रेनरों को "ऐसे कोई निर्देश" नहीं दिए गए हैं।
- "There is no instruction to link Aadhaar with the citizenship test.
  "आधार को नागरिकता जाँच से जोड़ने का कोई निर्देश नहीं है।
- The question is optional; if a person says that he or she has or does not have Aadhaar, it will be recorded as such," the Census official said.
  यह प्रश्न वैकल्पिक है; यदि कोई व्यक्ति कहता है कि उसके पास आधार है या नहीं है, तो इसे उसी रूप में दर्ज किया जाएगा," जनगणना अधिकारी ने कहा।
- Another question where the enumerators were told to be cautious was question number 10C, which asks for the caste of the respondent.
  एक अन्य प्रश्न, जिस पर प्रगणकों को सावधानी बरतने को कहा गया, प्रश्न संख्या 10C था, जिसमें उत्तरदाता की जाति पूछी जाती है।
- "You have to manually write the caste, as you are being told; there will be no drop-down box with options.
  "आपको बताई गई जाति को हाथ से दर्ज करना है; विकल्पों वाला कोई ड्रॉप-डाउन बॉक्स नहीं होगा।
- It is a sensitive question, and your job is not to argue or provide any commentary on the issue," the field trainer told the enumerators.
  यह एक संवेदनशील प्रश्न है और आपका काम इस मुद्दे पर बहस करना या कोई टिप्पणी करना नहीं है," फील्ड ट्रेनर ने प्रगणकों से कहा।
- "There will be no separate column for OBCs (Other Backward Classes)," he added.
  उन्होंने आगे कहा, "अन्य पिछड़ा वर्ग (OBC) के लिए अलग कॉलम नहीं होगा।"
- Other than Scheduled Caste and Scheduled Tribes, who can choose the names from a predetermined drop-down box, all others will have to type the caste name in an open column.
  अनुसूचित जाति और अनुसूचित जनजाति के लोग पहले से तय ड्रॉप-डाउन बॉक्स में से नाम चुन सकेंगे; इनके अलावा बाकी सभी को खुले कॉलम में जाति का नाम टाइप करना होगा।
- This is Independent India's first **caste enumeration**.
  यह स्वतंत्र भारत की पहली **जाति गणना** है।
- Question number 10 (C) says: "If not SC/ST in this State/U.T.,-Enter Caste name."
  प्रश्न संख्या 10 (C) में लिखा है: "यदि इस राज्य/केंद्रशासित प्रदेश में अनुसूचित जाति/अनुसूचित जनजाति से संबंधित नहीं हैं, तो जाति का नाम दर्ज करें।"
- There are two other options besides the Caste column — "Does not want to declare Caste" and "No Caste."
  जाति वाले कॉलम के अलावा दो अन्य विकल्प हैं—"जाति बताना नहीं चाहते" और "कोई जाति नहीं"।
- The data fields are marked "mandatory".
  डेटा फ़ील्ड को "अनिवार्य" के रूप में चिह्नित किया गया है।

Census 2027: The 40 Population Enumeration Questions

The **Registrar General and Census Commissioner of India (RG&CCI)**, under the **Ministry of Home Affairs**, notified the **40-question Household Schedule on 14 August 2026**, through **S.O. 4505(E)** under **Section 8(1) of the Census Act, 1948**. These questions

concern the **second phase—Population Enumeration**, distinct from the first-phase housing questionnaire.

Important clarification: The expression **"13 new questions"** depends on how related fields are grouped. Some are entirely new questions; others expand existing questions. **Religion was already covered in Census 2011 and should not be described as newly introduced.**

Personal, Family and Social Details

Question number	Notified question or information sought
1	Name of the person.
2	Relationship to the head of the household.
3	Sex.
4	Date of birth and age in completed years.
5	Current marital status.
6	Age at marriage in completed years.
7	Spouse's name.
8	Nationality, as declared.
9	Religion.
10	Scheduled Caste, Scheduled Tribe or caste.
11	Father's particulars.
12	Mother's particulars.
13	Disability.

These are the first **13 items** in the notified schedule. **Question 10 expands caste coverage beyond the earlier SC/ST enumeration.**

Language, Education and Employment

Question number	Notified question or information sought
14	Mother tongue and other languages known.
15	Literacy and digital literacy status.
16	Status of attendance in an educational institution.
17	Highest educational level attained and stream or discipline.
18	Whether the person worked at any time during the previous year.
19	Category of economic activity.
20	Occupation.
21	Nature of industry, trade or service.
22	Class of worker.
23	Non-economic activity, for marginal, semi-marginal and non-workers.
24	Whether seeking or available for work, for marginal, semi-marginal and

PATRIOTIC IAS

Question number	Notified question or information sought
	non-workers.
25	Travel to the place of work.

Occupation concerns the work performed, whereas **industry** concerns the economic activity of the establishment—for example, a person may work as an accountant in a textile factory.

Birthplace, Migration and Residence

Question number	Notified question or information sought
26	Birthplace.
27	Place of last residence.
28	Reason for migration.
29	Duration of stay in the present village or town since the last migration.
30	Permanent residential address.

Fertility, Banking and Identification Details

Question number	Notified question or information sought
31	Number of children surviving at present, for currently married, widowed, divorced and separated women only.
32	Number of children ever born alive, for currently married, widowed, divorced and separated women only.
33	Number of children born alive during the previous year, for currently married women only.
34	Place of COVID-19 vaccination.
35	Total number of bank accounts.
36	Mobile number, if available.
37	Aadhaar number, if available.
38	Voter ID number, if available.
39	Passport number, for Indian passport holders.
40	Availability of a driving licence.

Note: Question **40 asks about driving-licence availability**, whereas Question **39 specifically seeks the passport number**. The qualifiers attached to particular questions should be retained.

The 13 New or Expanded Question Areas Compared with Census 2011

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For a clear **13-area presentation**, the father's and mother's particulars can be grouped together as **parental particulars**. They remain **two separate numbered questions** in the actual schedule.

New or expanded area	Census 2027 question number	Nature of the addition
Spouse's name	**7**	Introduces a separate spouse-name field.
Nationality as declared	**8**	Introduces a separate nationality field compared with the 2011 Household Schedule.
Caste beyond SC/ST categories	**10**	Expands the existing SC/ST question to include caste more broadly.
Father's and mother's particulars	**11–12**	Introduces separate parental-information questions, grouped here as one area.
Digital literacy	**15**	Adds digital literacy to the existing literacy question.
Permanent residential address	**30**	Introduces a separate permanent-address field.
Place of COVID-19 vaccination	**34**	Introduces vaccination-location information.
Total number of bank accounts	**35**	Introduces an individual bank-account-count question.
Mobile number	**36**	Introduces this field in the Population Enumeration schedule, if available.
Aadhaar number	**37**	Introduces this field, if available.
Voter ID number	**38**	Introduces this field, if available.
Passport number	**39**	Introduces this field for Indian passport holders.
Driving-licence availability	**40**	Introduces a question about whether the person has a driving licence.

The comparison must distinguish **new standalone questions** from **new components within existing questions**. Reporting that counts parental questions separately, or includes other modifications, can therefore produce a different total.

GS Paper 1: Geography	03 November 2026
TOPICS COVERED	
03N11	How 'Murasu' became the first Tamil name for a tropical cyclone 'मुरासु' उष्णकटिबंधीय चक्रवात का पहला तमिल नाम कैसे बना
03N11	Cascading effect श्रृंखलाबद्ध प्रभाव
03N11	Quiz
03N11	Yemen's Houthis say they targeted Saudi Arabia's Dammam airport यमन के हूतियों का कहना है कि उन्होंने सऊदी अरब के दम्माम हवाई अड्डे को निशाना बनाया

How 'Murasu' became the first Tamil name for a tropical cyclone

GS I: Geography

K. Lakshmi
CHENNAI

A name rooted in Tamil's cultural past is now travelling far and wide. As a severe cyclonic storm advances towards the Indian coast, 'Murasu', a Tamil name suggested by the Regional Meteorological Centre (RMC), has found a place in the region's meteorological history.

'Murasu' is a traditional Tamil percussion instrument. The name was chosen from the second list of names for tropical cyclones over the north Indian Ocean that was prepared by the World Meteorological Organisation (WMO) panel.

S. Balachandran, former Additional Director-General of Meteorology, who was heading the RMC when the names were proposed, said that 'Murasu' was the first Tamil name to be assigned to a tropical cyclone since the naming of cyclones over the north Indian Ocean began in September 2004.

"The name 'Murasu' was proposed because the instrument was used to disseminate information during the ancient period, and to alert the people to natural disasters. It also denoted a thunderous sound," he said.

Mr. Balachandran recalled that, after the names in the first list were exhausted, the Regional Specialised Meteorological Centre for Tropical Cyclones over North Indian Ocean, New Delhi, sought a new list of names from all the coastal States in 2020.

Gati and Tej

Meteorologists said 'Murasu' was the third name, after 'Gati' and 'Tej', to be featured in the list of 13 names suggested by India to the WMO and the United Nations Economic and Social Commission for Asia and the Pacific panel.

N. Puviarasan, Head, Meteorological Centre, Bengaluru, who was then posted at the RMC, Chennai, recalled that it had given names including 'Thirukai', 'Kalappai', 'Yer', and 'Naavai', related to ocean, fishing, and agriculture. But these did not make it to the list.

The names had to meet several criteria, including ease of pronunciation, a maximum length of eight letters, and neutrality.

03N11. How 'Murasu' became the first Tamil name for a tropical cyclone

'मुरासु' उष्णकटिबंधीय चक्रवात का पहला तमिल नाम कैसे बना

- A name rooted in Tamil's cultural past is now travelling far and wide.

तमिल की सांस्कृतिक विरासत से जुड़ा एक नाम अब दूर-दूर तक पहुँच रहा है।

- As a severe cyclonic storm advances towards the Indian coast, 'Murasu', a Tamil name suggested by the Regional Meteorological Centre (RMC), has found a place in the region's meteorological history.

एक गंभीर चक्रवाती तूफ़ान भारतीय तट की ओर बढ़ रहा है और इसी बीच क्षेत्रीय मौसम विज्ञान केंद्र (RMC) द्वारा सुझाए गए तमिल नाम 'मुरासु' ने इस क्षेत्र के मौसम विज्ञान के इतिहास में जगह बना ली है।

- 'Murasu' is a traditional Tamil percussion instrument.

'मुरासु' एक पारंपरिक तमिल तालवाद्य है।

- The name was chosen from the second list of names for **tropical cyclones over the north Indian Ocean** that was prepared by the World Meteorological Organisation (WMO) panel.

यह नाम विश्व मौसम विज्ञान संगठन (WMO) के पैनल द्वारा तैयार **उत्तर हिंद महासागर के उष्णकटिबंधीय चक्रवातों** के लिए नामों की दूसरी सूची से चुना गया था।

- S. Balachandran, former Additional Director-General of Meteorology, who was heading the RMC when the names were proposed, said that 'Murasu' was the first Tamil name to be assigned to a tropical cyclone since the naming of cyclones over the north Indian Ocean began in September 2004.

मौसम विज्ञान के पूर्व अतिरिक्त महानिदेशक एस. बालचंद्रन, जो नाम सुझाए जाने के समय RMC का नेतृत्व कर रहे थे, ने कहा कि सितंबर 2004 में उत्तर हिंद महासागर के चक्रवातों का नामकरण शुरू होने के बाद 'मुरासु' किसी उष्णकटिबंधीय चक्रवात को दिया गया पहला तमिल नाम है।

- "The name 'Murasu' was proposed because the instrument was used to disseminate information during the ancient period, and to alert the people to natural disasters.

उन्होंने कहा, "'मुरासु' नाम इसलिए सुझाया गया क्योंकि प्राचीन काल में इस वाद्य का इस्तेमाल सूचना प्रसारित करने और लोगों को प्राकृतिक आपदाओं के प्रति सचेत करने के लिए किया जाता था।

- It also denoted a thunderous sound," he said.

यह गरजदार ध्वनि का भी प्रतीक था।"

- Mr. Balachandran recalled that, after the names in the first list were exhausted, the Regional Specialised Meteorological Centre for Tropical Cyclones over North Indian Ocean, New Delhi, sought a new list of names from all the coastal States in 2020.

श्री बालचंद्रन ने याद किया कि पहली सूची के नाम समाप्त हो जाने के बाद, नई दिल्ली स्थित उत्तर हिंद महासागर के उष्णकटिबंधीय चक्रवातों के लिए क्षेत्रीय विशिष्ट मौसम विज्ञान केंद्र ने 2020 में सभी तटीय राज्यों से नामों की नई सूची माँगी थी।

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Gati and Tej
'गति' और 'तेज'

- Meteorologists said 'Murasu' was the third name, after 'Gati' and 'Tej', to be featured in the list of 13 names suggested by India to the WMO and the United Nations Economic and Social Commission for Asia and the Pacific panel.
  मौसम विज्ञानियों ने कहा कि 'गति' और 'तेज' के बाद 'मुरासु' भारत द्वारा WMO और संयुक्त राष्ट्र एशिया एवं प्रशांत आर्थिक तथा सामाजिक आयोग के पैनल को सुझाए गए 13 नामों की सूची में शामिल होने वाला तीसरा नाम था।
- N. Puviarasan, Head, Meteorological Centre, Bengaluru, who was then posted at the RMC, Chennai, recalled that it had given names including 'Thirukai', 'Kalappai', 'Yer', and 'Naavai', related to ocean, fishing, and agriculture.
  मौसम केंद्र, बेंगलुरु के प्रमुख एन. पुवियारासन, जो उस समय RMC, चेन्नई में तैनात थे, ने याद किया कि केंद्र ने समुद्र, मछली पकड़ने और कृषि से जुड़े 'तिरुकै', 'कलप्पै', 'एर' और 'नावै' सहित कई नाम दिए थे।
- But these did not make it to the list.
  लेकिन ये नाम सूची में शामिल नहीं हो पाए।
- The names had to meet several criteria, including ease of pronunciation, a maximum length of eight letters, and neutrality.
  नामों को कई मानदंडों पर खरा उतरना था, जिनमें उच्चारण में आसानी, अधिकतम आठ अक्षरों की लंबाई और तटस्थता शामिल थे।

Cascading effect

India must respect land rights of its people while building dams

GS I: Geography

The bureaucratic impetus for the 11.2-GW Siang Upper Multipurpose Project (SUMP) in Arunachal Pradesh purportedly comes from China's aggressive development of a 60-GW mega-dam in Tibet, stoking anxieties among Indian authorities over 'weaponised' transboundary waters. Beijing may be able to divert flows in the Yarlung Tsangpo river, which becomes the Brahmaputra in India, to cause drought downstream or release water en masse to trigger catastrophic floods in Arunachal Pradesh and Assam. New Delhi thus imagines SUMP as a strategic buffer, but in so doing faces a dilemma it should not attempt to resolve with force. Its extant top-down approach, exemplified by deploying security forces to guard survey teams and imposing the State Unlawful Activities (Prevention) Act against activists, only validates fears among locals that the state will grab their land. The region also hosts sustained protests against the Subansiri Upper Hydroelectric Project, expanding the indictment to Arunachal Pradesh's model of hydroelectric power development. The eastern Himalayas are among the most tectonically active and erosion-prone landscapes in the world. The mega-dam in Tibet will comprise five cascading power stations over the river's roughly 2,000-metre fall over 50 km. Beijing has maintained the dam will not harm countries downstream but has declined to share crucial engineering details. This is why diplomacy will be an essential part of operating SUMP, in addition to Beijing's disputed claims on Arunachal Pradesh.

The Brahmaputra basin in Assam and Bangladesh receives most of its water from monsoon rains and tributaries downstream of the Tibetan Plateau, so China cannot straightforwardly control the river's total flow through India. Yet since Chinese interventions would have greater consequences closer to the border, SUMP will need information about both the mega-dam's operations and downstream inflows to plan its own operations, and Beijing has declined to share the former. SUMP thus faces many uncertainties at the outset. Despite India repeatedly raising the issue with China at the highest levels, headway has been limited to Beijing agreeing to share hydrological data on humanitarian grounds during emergencies. Planners have contemplated maintaining the SUMP reservoir at 70% to accommodate unexpected surges, but the level of protection possible if China supplies no advance warning remains unclear. This uncertainty is a thorn in the side of the government's push against more legitimate resistance by Adi community members and civil rights groups. The need for the project does not excuse the state from following all the relevant laws and protections. The state cannot protect the nation's needs by antagonising the nation's people.

03N11. Cascading effect
श्रृंखलाबद्ध प्रभाव

- The bureaucratic impetus for the 11.2-GW **Siang Upper Multipurpose Project (SUMP)** in Arunachal Pradesh purportedly comes from China's aggressive development of a 60-GW mega-dam in Tibet, stoking anxieties among Indian authorities over 'weaponised' transboundary waters.
  अरुणाचल प्रदेश में 11.2 गीगावाट की **सियांग अपर बहुउद्देशीय परियोजना (SUMP)** को आगे बढ़ाने के पीछे कथित तौर पर तिब्बत में चीन द्वारा 60 गीगावाट का विशाल बाँध आक्रामक ढंग से बनाने की पहल है। इससे भारतीय अधिकारियों में सीमापार जल को 'हथियार' की तरह इस्तेमाल किए जाने की आशंका बढ़ी है।
- Beijing may be able to divert flows in the Yarlung Tsangpo river, which becomes the Brahmaputra in India, to cause drought downstream or release water en masse to trigger catastrophic floods in Arunachal Pradesh and Assam.
  बीजिंग यारलुंग त्सांगपो नदी—जो भारत में ब्रह्मपुत्र बन जाती है—के प्रवाह को मोड़कर निचले क्षेत्रों में सूखा पैदा कर सकता है, या बड़ी मात्रा में पानी छोड़कर अरुणाचल प्रदेश और असम में विनाशकारी बाढ़ ला सकता है।
- New Delhi thus imagines SUMP as a strategic buffer, but in so doing faces a dilemma it should not attempt to resolve with force.
  इसलिए नई दिल्ली SUMP को एक रणनीतिक सुरक्षा-कवच के रूप में देखती है, लेकिन इस प्रक्रिया में उसके सामने ऐसी दुविधा है जिसे बल प्रयोग से सुलझाने की कोशिश नहीं करनी चाहिए।
- Its extant top-down approach, exemplified by deploying security forces to guard survey teams and imposing the State Unlawful Activities (Prevention) Act against activists, only validates fears among locals that

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the state will grab their land.
उसका मौजूदा ऊपर से थोपा जाने वाला रवैया—जिसका उदाहरण सर्वेक्षण दलों की सुरक्षा के लिए सुरक्षा बलों की तैनाती और कार्यकर्ताओं पर राज्य का गैरकानूनी गतिविधियाँ (रोकथाम) अधिनियम लगाना है—स्थानीय लोगों की इस आशंका को ही सही साबित करता है कि सरकार उनकी ज़मीन हथिया लेगी।

- The region also hosts sustained protests against the Subansiri Upper Hydroelectric Project, expanding the indictment to Arunachal Pradesh's model of hydroelectric power development.
इस क्षेत्र में सुबनसिरी अपर जलविद्युत परियोजना के खिलाफ़ लगातार विरोध प्रदर्शन भी हो रहे हैं, जिससे अरुणाचल प्रदेश की जलविद्युत विकास-नीति पर भी सवाल उठते हैं।
- The eastern Himalayas are among the most tectonically active and erosion-prone landscapes in the world.
पूर्वी हिमालय दुनिया के सबसे अधिक विवर्तनिक रूप से सक्रिय और भू-क्षरण की आशंका वाले क्षेत्रों में से हैं।
- The mega-dam in Tibet will comprise five cascading power stations over the river's roughly 2,000-metre fall over 50 km.
तिब्बत में बन रहे विशाल बाँध में नदी के लगभग 50 किलोमीटर के मार्ग पर 2,000 मीटर की कुल ढलान के साथ पाँच क्रमिक बिजलीघर होंगे।
- Beijing has maintained the dam will not harm countries downstream but has declined to share crucial engineering details.
बीजिंग का कहना है कि इस बाँध से निचले क्षेत्रों के देशों को नुकसान नहीं होगा, लेकिन उसने इंजीनियरिंग से जुड़ी महत्त्वपूर्ण जानकारी साझा करने से इनकार किया है।
- This is why **diplomacy** will be an essential part of operating SUMP, in addition to Beijing's disputed claims on Arunachal Pradesh.
इसीलिए SUMP के संचालन में **कूटनीति** अनिवार्य होगी—इसके अलावा अरुणाचल प्रदेश पर बीजिंग के विवादित दावे भी एक चुनौती हैं।
- The Brahmaputra basin in Assam and Bangladesh receives most of its water from monsoon rains and tributaries downstream of the Tibetan Plateau, so China cannot straightforwardly control the river's total flow through India.
असम और बांग्लादेश में ब्रह्मपुत्र बेसिन को अपना अधिकांश पानी मानसूनी वर्षा और तिब्बती पठार के नीचे की सहायक नदियों से मिलता है, इसलिए चीन भारत से होकर बहने वाली नदी के कुल प्रवाह को सीधे तौर पर नियंत्रित नहीं कर सकता।
- Yet since Chinese interventions would have greater consequences closer to the border, SUMP will need information about both the mega-dam's operations and downstream inflows to plan its own operations, and Beijing has declined to share the former.
फिर भी, सीमा के निकट चीनी हस्तक्षेपों के अधिक गंभीर परिणाम हो सकते हैं। इसलिए अपने संचालन की योजना बनाने के लिए SUMP को विशाल बाँध के संचालन और निचले क्षेत्रों से आने वाले जल-प्रवाह—दोनों की जानकारी चाहिए होगी, लेकिन बीजिंग ने बाँध के संचालन की जानकारी साझा करने से इनकार किया है।
- SUMP thus faces many uncertainties at the outset.
इस प्रकार, शुरुआत से ही SUMP के सामने कई अनिश्चितताएँ हैं।
- Despite India repeatedly raising the issue with China at the highest levels, headway has been limited to Beijing agreeing to share hydrological data on humanitarian grounds during emergencies.
भारत द्वारा उच्चतम स्तरों पर बार-बार यह मुद्दा उठाए जाने के बावजूद, प्रगति केवल इतनी हुई है कि बीजिंग ने आपात स्थितियों में मानवीय आधार पर जल-विज्ञान संबंधी आँकड़े साझा करने पर सहमति दी है।
- Planners have contemplated maintaining the SUMP reservoir at 70% to accommodate unexpected surges, but the level of protection possible if China supplies no advance warning remains unclear.
योजनाकारों ने अप्रत्याशित रूप से बढ़े जल-प्रवाह को सँभालने के लिए SUMP के जलाशय को 70% तक भरा रखने पर विचार किया है, लेकिन यदि चीन पहले से कोई चेतावनी न दे तो कितनी सुरक्षा संभव होगी, यह स्पष्ट नहीं है।

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- This uncertainty is a thorn in the side of the government's push against more legitimate resistance by Adi community members and civil rights groups.
  यह अनिश्चितता, आदी समुदाय के सदस्यों और नागरिक अधिकार समूहों के अधिक जायज़ विरोध के बावजूद परियोजना को आगे बढ़ाने की सरकारी कोशिश के लिए एक बड़ी बाधा है।
- The need for the project does not excuse the state from following all the relevant laws and protections.
  परियोजना की आवश्यकता सरकार को सभी संबंधित कानूनों और सुरक्षा उपायों का पालन करने से छूट नहीं देती।
- The state cannot protect the nation's needs by antagonising the nation's people.
  सरकार देश के लोगों को नाराज़ करके राष्ट्र की ज़रूरतों की रक्षा नहीं कर सकती।

Answers to October 27 quiz:
1. When mountaineers don't receive enough oxygen for normal function
– Ans: Hypoxia
2. Mountain range whose name means "abode of snow"
– Ans: Himalaya
3. Country with the most 8K mountains; climber who summited all 14 of them
– Ans: Nepal; Nirmal Purja
4. Lowest layer of the earth's atmosphere
– Ans: Troposphere
5. Tallest mountain from base to summit; ocean in which it lies
– Ans: Mauna Kea; Pacific Ocean

03N11. Quiz

1. Hypoxia: Insufficient Oxygen for Normal Function

- Hypoxia occurs when body tissues do not receive enough oxygen to function normally. In mountaineers, it commonly results from reduced atmospheric pressure at high altitude.
- Oxygen still constitutes approximately 21% of dry air, but its partial pressure decreases with elevation. Consequently, less oxygen enters the bloodstream with each breath.
- Reduced oxygen availability can impair physical performance, concentration and coordination, and may contribute to headache, dizziness and breathlessness.
- Gradual ascent allows acclimatisation through changes such as increased breathing. Hypoxia describes oxygen deficiency; it is not synonymous with every altitude-related illness.

2. Himalaya: The "Abode of Snow"

- The name Himalaya comes from the Sanskrit words hima, meaning snow, and alaya, meaning abode or dwelling. Together, they mean "abode of snow."

3. Nepal's Eight-Thousanders and Nirmal Purja

- Eight-thousanders are the fourteen conventionally recognised independent mountains exceeding 8,000 metres above sea level. Nepal contains or shares eight of these mountains, including Everest, Lhotse, Makalu and Annapurna I.
- The wording "country with the most" requires caution because several mountains straddle international borders; Nepal's count should not imply exclusive ownership.
- Nirmal "Nims" Purja, a Nepali mountaineer, completed his celebrated Project Possible in 2019, climbing the fourteen eight-thousanders in approximately six months.
- His achievement concerns a rapid climbing campaign. He was not the first person ever to complete all fourteen mountains.

4. Troposphere: The Lowest Atmospheric Layer

- The troposphere is the lowest layer of Earth's atmosphere, beginning at the surface and extending upward to the tropopause, its upper boundary.
- Its thickness varies with latitude, season and weather conditions. It is generally deeper over the warm equatorial region and shallower towards the poles.
- This layer contains most atmospheric water vapour and approximately 75% of the atmosphere's mass. Almost all familiar weather, including clouds, rainfall and thunderstorms, develops here.

- Temperature generally decreases with increasing altitude, although temperature inversions can occur. Above the tropopause lies the stratosphere, containing the principal ozone layer.

5. Mauna Kea: Tallest from Base to Summit

- Mauna Kea is a volcano on the island of Hawai'i in the Pacific Ocean. It is commonly recognised as Earth's tallest mountain when measured from its submarine base to its summit.
- Its summit stands approximately 4,207 metres above sea level, while its full height from the ocean floor exceeds 10,000 metres.
- Much of the mountain therefore remains submerged, making its visible elevation substantially smaller than its total height.
- Mount Everest remains the highest mountain above sea level. The distinction depends on the measurement's starting point: sea level or the mountain's underwater base.


Yemen's Houthis say they targeted Saudi Arabia's Dammam airport

AFP

GS I: Geography

Yemen's Iran-aligned Houthis on Monday said they targeted Dammam airport in Saudi Arabia with two drones, following weeks of attacks against the oil-rich kingdom. Military spokesman Yahya Saree also claimed strikes on an early-warning radar and a military transport plane in the kingdom's southwest. AFP

03N11. Yemen's Houthis say they targeted Saudi Arabia's Dammam airport

यमन के हूतियों का कहना है कि उन्होंने सऊदी अरब के दम्माम हवाई अड्डे को निशाना बनाया

- Yemen's Iran-aligned Houthis on Monday said they targeted Dammam airport in Saudi Arabia with two drones, following weeks of attacks against the oil-rich kingdom.

ईरान-समर्थित यमन के हूतियों ने सोमवार को कहा कि उन्होंने दो ड्रोन से सऊदी अरब के दम्माम हवाई अड्डे को निशाना बनाया। इससे पहले कई सप्ताह तक तेल-समृद्ध इस देश पर हमले किए गए थे।

- Military spokesman Yahya Saree also claimed strikes on an early-warning radar and a military transport plane in the kingdom's southwest.

सैन्य प्रवक्ता याह्या सरी ने देश के दक्षिण-पश्चिम में एक पूर्व-चेतावनी रडार और सैन्य परिवहन विमान पर हमले करने का दावा भी किया।

GS Paper II: Polity	03 November 2026
TOPICS COVERED	
03N11	What is the role of Legislative Councils? विधान परिषदों की क्या भूमिका है?

What is the role of Legislative Councils?

What is the constitutional basis for Legislative Councils in the States? What were the arguments for and against? How are members elected and nominated? What powers do Legislative Councils have in relation to Legislative Assemblies? What reforms did the Second Administrative Reforms Commission propose?

GS II: Polity

EXPLAINER

Rangarajan R.

The story so far:

Elections to 28 Legislative Council seats were held last week in Uttar Pradesh, Bihar, Maharashtra and Karnataka. The exchanges among political parties and their leaders, including the Prime Minister, following the election results had piqued public curiosity about Legislative Councils.

Legislative Councils in British India

The Government of India Act, 1935 introduced bicameral legislatures in six large provinces of Madras, Bombay, Bengal, the United Provinces, Bihar and Assam. The electoral college for these councils was highly restricted and elitist, granting voting rights to only a very wealthy or educated minority.

They were to act as a revising chamber to review the work of Provincial Legislative Assemblies. These councils were not subject to dissolution, and the term of individual members was nine years, with one-third of members retiring every three years. Interestingly, these Legislative Councils had equal powers with the Legislative Assemblies with respect to passage of bills. If there was any disagreement, or if a bill was kept pending in the council for 12 months, the Governor may resolve such deadlock only by summoning a joint sitting of the provincial Assembly and Council.

Constituent Assembly debates

The debates around constituting Legislative Councils in States were highly contested in the Constituent Assembly. Some members favoured it on the ground that it would act as a check and balance against hasty legislation by popularly elected Legislative Assemblies. Others viewed it as an unnecessary burden on the public exchequer. There were also objections to leaving out most important aspects of the constitution of Legislative Councils to ordinary legislation of Parliament without clearly specifying them in the Constitution itself. Finally, after considerable debate, the provisions with respect to Legislative Councils were adopted.



BJP leaders celebrate after winning four seats in Karnataka Legislative Council polls, on October 28. PTI

Structure of State councils

Article 168 of the Constitution provides that the State legislature of Maharashtra, Uttar Pradesh, Bihar, Andhra Pradesh, Telangana and Karnataka shall have a Legislative Council.

Article 169 stipulates that Parliament may by ordinary law provide for the abolition or creation of a Legislative Council in a State. However, Parliament may pass such a law only if the Legislative Assembly of the State passes a resolution to that effect by a two-thirds majority.

Article 171 provides that the maximum number of members in a council shall not exceed one-third of the total membership of the Legislative Assembly, subject to a minimum of 40. The members of the council shall be elected as follows: one-third by municipality and local body members; one-twelfth by graduates for at least three years; one-twelfth by secondary school teachers for at least three years; one-third by MLAs of the State; and the remaining one-sixth to be nominated. Article 172 provides that the Legislative Council in a State is not subject to dissolution, and the term of individual members is six years, with one-third of members retiring every two years.

The ministers in a State, including the Chief Minister, can be from its Legislative Council, just like ministers in the Centre can be from the Rajya Sabha.

However, when it comes to legislative procedure, the council does not have significant powers. There is no requirement for a joint sitting to break any deadlock between the Assembly and Council with respect to bills. In case of disagreement, the bill as passed by the Assembly is considered final, with the Council only having the option to delay the passage of a bill for a maximum of four months.

Issues and way forward

The abolition or creation of Legislative Councils in the past has been primarily driven by political considerations. For instance, the Tamil Nadu Legislative Council was abolished in 1986 when M. G. Ramachandran was the Chief Minister. There was a resolution in the assembly to re-establish it in 2010 when M. Karunanidhi was the Chief Minister. However, before the Parliamentary law for creation could be notified, the Assembly in 2011 had passed a resolution against the revival of the council when J. Jayalalithaa became Chief Minister. Similarly, the Andhra Pradesh council was abolished in 1985 when N. T. Rama Rao became the Chief Minister, only to be later created again in 2007.

The second Administrative Reforms Commission (ARC) in its report on Local Governance (2007) had proposed that Parliament may, by law, create a Legislative Council in all States as 'Council of local governments'. It argued that, given the country's increased literacy rates, there was no longer a need for a separate electorate of graduates and teachers. Instead, all the members of the council can be elected solely by local body representatives.

The second ARC's recommendation may be deliberated and suitably implemented. Despite limited legislative powers of the council, this arrangement may enable it to function as an effective 'revising house', protecting and empowering the interests of local bodies. Otherwise, they may as well be abolished in the existing six States, rather than remaining as a mere ornament in those State legislatures.

(Rangarajan R is a former IAS officer and author of 'Courseware on Polity Simplified.' He currently trains at Officers IAS Academy. Views expressed are personal)

THE GIST

- Legislative Councils were envisaged as revising chambers to check hasty legislation by State Assemblies, but their creation and abolition have often been driven by political considerations
- Though the Constitution provides for their composition, tenure, and role, Legislative Councils have limited legislative powers and can only delay the passage of bills
- The Second Administrative Reforms Commission recommended transforming them into councils of local governments, with members elected solely by local body representatives, to strengthen local self-government

03N11. What is the role of Legislative Councils?
विधान परिषदों की क्या भूमिका है?

- Elections to 28 Legislative Council seats were held last week in Uttar Pradesh, Bihar, Maharashtra and Karnataka.
  पिछले सप्ताह उत्तर प्रदेश, बिहार, महाराष्ट्र और कर्नाटक में विधान परिषद की 28 सीटों के लिए चुनाव हुए।
- The exchanges among political parties and their leaders, including the Prime Minister, following the election results had piqued public curiosity about Legislative Councils.
  चुनाव परिणामों के बाद प्रधानमंत्री सहित राजनीतिक दलों और उनके नेताओं के बीच हुई बयानबाज़ी ने विधान परिषदों के बारे में लोगों की जिज्ञासा बढ़ा दी थी।

Legislative Councils in British India
ब्रिटिश भारत में विधान परिषदें

- The Government of India Act, 1935 introduced **bicameral legislatures** in six large provinces of Madras, Bombay, Bengal, the United Provinces, Bihar and Assam.
  भारत सरकार अधिनियम, 1935 ने मद्रास, बंबई, बंगाल, संयुक्त प्रांत, बिहार और असम के छह बड़े प्रांतों में **द्विसदनीय विधानमंडल** शुरू किए।
- The electoral college for these councils was highly restricted and elitist, granting voting rights to only a very wealthy or educated minority.

इन परिषदों के लिए निर्वाचक मंडल अत्यंत सीमित और अभिजात्य था; इसमें केवल बहुत धनी या शिक्षित अल्पसंख्यक वर्ग को मतदान का अधिकार था।

- They were to act as a **revising chamber** to review the work of Provincial Legislative Assemblies.
  इन परिषदों का काम प्रांतीय विधानसभाओं के कार्यों की समीक्षा करने वाले **पुनरीक्षण सदन** के रूप में काम करना था।
- These councils were not subject to dissolution, and the term of individual members was nine years, with one-third of members retiring every three years.
  इन परिषदों को भंग नहीं किया जा सकता था और सदस्यों का कार्यकाल नौ वर्ष का था; हर तीन वर्ष में एक-तिहाई सदस्य सेवानिवृत्त होते थे।
- Interestingly, these Legislative Councils had equal powers with the Legislative Assemblies with respect to passage of bills.
  दिलचस्प बात यह है कि विधेयक पारित करने के मामले में इन विधान परिषदों के पास विधानसभाओं के बराबर अधिकार थे।
- If there was any disagreement, or if a bill was kept pending in the council for 12 months, the Governor may resolve such deadlock only by summoning a joint sitting of the provincial Assembly and Council.
  यदि कोई असहमति होती या कोई विधेयक परिषद में 12 महीने तक लंबित रहता, तो राज्यपाल प्रांतीय विधानसभा और परिषद की संयुक्त बैठक बुलाकर ही इस गतिरोध को दूर कर सकते थे।

Constituent Assembly debates
संविधान सभा में बहस

- The debates around constituting Legislative Councils in States were highly contested in the Constituent Assembly.
  राज्यों में विधान परिषदों के गठन को लेकर संविधान सभा में तीखी बहस हुई थी।
- Some members favoured it on the ground that it would act as a check and balance against hasty legislation by popularly elected Legislative Assemblies.
  कुछ सदस्यों ने इसका समर्थन यह कहते हुए किया कि यह लोकप्रिय रूप से निर्वाचित विधानसभाओं द्वारा जल्दबाज़ी में बनाए गए कानूनों पर नियंत्रण और संतुलन का काम करेगी।
- Others viewed it as an unnecessary burden on the public exchequer.
  दूसरों की नज़र में यह सरकारी ख़ज़ाने पर एक अनावश्यक बोझ थी।
- There were also objections to leaving out most important aspects of the constitution of Legislative Councils to ordinary legislation of Parliament without clearly specifying them in the Constitution itself.
  इस बात पर भी आपत्ति जताई गई कि विधान परिषदों की संरचना के अधिकांश महत्वपूर्ण पहलुओं को संविधान में स्पष्ट रूप से तय करने के बजाय संसद के सामान्य कानूनों पर छोड़ दिया जाए।
- Finally, after considerable debate, the provisions with respect to Legislative Councils were adopted.
  अंततः, काफ़ी बहस के बाद विधान परिषदों से संबंधित प्रावधान स्वीकार कर लिए गए।

Structure of State Councils
राज्य विधान परिषदों की संरचना

- Article 168 of the Constitution provides that the State legislature of Maharashtra, Uttar Pradesh, Bihar, Andhra Pradesh, Telangana and Karnataka shall have a Legislative Council.
  संविधान का अनुच्छेद 168 प्रावधान करता है कि महाराष्ट्र, उत्तर प्रदेश, बिहार, आंध्र प्रदेश, तेलंगाना और कर्नाटक के राज्य विधानमंडलों में विधान परिषद होगी।

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- Article 169 stipulates that Parliament may by ordinary law provide for the abolition or creation of a Legislative Council in a State.
  अनुच्छेद 169 के अनुसार, संसद सामान्य कानून बनाकर किसी राज्य में विधान परिषद को समाप्त या स्थापित कर सकती है।
- However, Parliament may pass such a law only if the Legislative Assembly of the State passes a resolution to that effect by a two-thirds majority.
  हालाँकि, संसद ऐसा कानून तभी पारित कर सकती है जब संबंधित राज्य की विधानसभा इस आशय का प्रस्ताव दो-तिहाई बहुमत से पारित करे।
- Article 171 provides that the maximum number of members in a council shall not exceed one-third of the total membership of the Legislative Assembly, subject to a minimum of 40.
  अनुच्छेद 171 के अनुसार, किसी परिषद के सदस्यों की अधिकतम संख्या विधानसभा के कुल सदस्यों की संख्या के एक-तिहाई से अधिक नहीं हो सकती, जबकि सदस्यों की न्यूनतम संख्या 40 होनी चाहिए।
- The members of the council shall be elected as follows: one-third by municipality and local body members; one-twelfth by graduates for at least three years; one-twelfth by secondary school teachers for at least three years; one-third by MLAs of the State; and the remaining one-sixth to be nominated.
  परिषद के सदस्यों का चुनाव इस प्रकार होगा: एक-तिहाई सदस्य नगरपालिकाओं और स्थानीय निकायों के सदस्यों द्वारा; एक-बारहवाँ हिस्सा कम-से-कम तीन वर्ष से स्नातक मतदाताओं द्वारा; एक-बारहवाँ हिस्सा कम-से-कम तीन वर्ष से माध्यमिक विद्यालयों के शिक्षकों द्वारा; एक-तिहाई राज्य के विधायकों द्वारा चुना जाएगा; और शेष एक-छठा हिस्सा मनोनीत किया जाएगा।
- Article 172 provides that the Legislative Council in a State is not subject to dissolution, and the term of individual members is six years, with one-third of members retiring every two years.
  अनुच्छेद 172 के अनुसार, किसी राज्य की विधान परिषद को भंग नहीं किया जा सकता। सदस्यों का कार्यकाल छह वर्ष का होता है और हर दो वर्ष में एक-तिहाई सदस्य सेवानिवृत्त होते हैं।
- The ministers in a State, including the Chief Minister, can be from its Legislative Council, just like ministers in the Centre can be from the Rajya Sabha.
  केंद्र में मंत्रियों के राज्यसभा से होने की तरह, राज्य में मुख्यमंत्री सहित मंत्री विधान परिषद के सदस्य हो सकते हैं।
- However, when it comes to legislative procedure, the council does not have significant powers.
  हालाँकि, विधायी प्रक्रिया के मामले में परिषद के पास महत्त्वपूर्ण अधिकार नहीं होते।
- There is no requirement for a joint sitting to break any deadlock between the Assembly and Council with respect to bills.
  विधेयकों को लेकर विधानसभा और परिषद के बीच गतिरोध दूर करने के लिए संयुक्त बैठक बुलाने का कोई प्रावधान नहीं है।
- In case of disagreement, the bill as passed by the Assembly is considered final, with the Council only having the option to delay the passage of a bill for a maximum of four months.
  असहमति होने पर विधानसभा द्वारा पारित विधेयक को अंतिम माना जाता है; परिषद के पास विधेयक को अधिकतम चार महीने तक रोकने का ही विकल्प होता है।

Issues and way forward
मुद्दे और आगे की राह

- The abolition or creation of Legislative Councils in the past has been primarily driven by political considerations.
  अतीत में विधान परिषदों को समाप्त करने या स्थापित करने के फैसले मुख्यतः राजनीतिक विचारों से प्रेरित रहे हैं।

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- For instance, the Tamil Nadu Legislative Council was abolished in 1986 when M. G. Ramachandran was the Chief Minister.
  उदाहरण के लिए, तमिलनाडु विधान परिषद को 1986 में समाप्त कर दिया गया था, जब एम. जी. रामचंद्रन मुख्यमंत्री थे।
- There was a resolution in the Assembly to re-establish it in 2010 when M. Karunanidhi was the Chief Minister.
  2010 में, जब एम. करुणानिधि मुख्यमंत्री थे, इसे फिर से स्थापित करने के लिए विधानसभा में एक प्रस्ताव पारित किया गया।
- However, before the Parliamentary law for creation could be notified, the Assembly in 2011 had passed a resolution against the revival of the council when J. Jayalalithaa became Chief Minister.
  हालाँकि, परिषद की स्थापना के लिए संसद का कानून अधिसूचित होने से पहले ही, 2011 में जे. जयललिता के मुख्यमंत्री बनने पर विधानसभा ने इसे फिर से शुरू करने के विरोध में प्रस्ताव पारित कर दिया।
- Similarly, the Andhra Pradesh Council was abolished in 1985 when N. T. Rama Rao became the Chief Minister, only to be later created again in 2007.
  इसी तरह, 1985 में एन. टी. रामाराव के मुख्यमंत्री बनने पर आंध्र प्रदेश विधान परिषद समाप्त कर दी गई थी, लेकिन बाद में 2007 में इसे फिर से स्थापित किया गया।
- The Second Administrative Reforms Commission (ARC) in its report on Local Governance (2007) had proposed that Parliament may, by law, create a Legislative Council in all States as a 'Council of local governments'.
  दूसरे प्रशासनिक सुधार आयोग (ARC) ने स्थानीय शासन पर अपनी 2007 की रिपोर्ट में प्रस्ताव दिया था कि संसद कानून बनाकर सभी राज्यों में 'स्थानीय सरकारों की परिषद' के रूप में विधान परिषद स्थापित कर सकती है।
- It argued that, given the country's increased literacy rates, there was no longer a need for a separate electorate of graduates and teachers.
  आयोग का तर्क था कि देश में साक्षरता दर बढ़ने के बाद स्नातकों और शिक्षकों के लिए अलग निर्वाचक मंडल की आवश्यकता नहीं रह गई थी।
- Instead, all the members of the council can be elected solely by local body representatives.
  इसके बजाय, परिषद के सभी सदस्यों का चुनाव केवल स्थानीय निकायों के प्रतिनिधियों द्वारा किया जा सकता है।
- The Second ARC's recommendation may be deliberated and suitably implemented.
  दूसरे ARC की सिफ़ारिश पर विचार करके उसे उपयुक्त रूप से लागू किया जा सकता है।
- Despite limited legislative powers of the council, this arrangement may enable it to function as an effective 'revising house', protecting and empowering the interests of local bodies.
  परिषद के सीमित विधायी अधिकारों के बावजूद, यह व्यवस्था उसे एक प्रभावी **पुनरीक्षण सदन** के रूप में काम करने और स्थानीय निकायों के हितों की रक्षा तथा उन्हें सशक्त बनाने में सक्षम कर सकती है।
- Otherwise, they may as well be abolished in the existing six States, rather than remaining as a mere ornament in those State legislatures.
  अन्यथा, मौजूदा छह राज्यों में उन्हें केवल विधानमंडलों की शोभा बढ़ाने वाला औपचारिक अंग बनाए रखने के बजाय समाप्त ही कर देना चाहिए।

GS Paper II: International Relations	03 November 2026
TOPICS COVERED	
03N11	Western Sahara refugees still yearn for home as UN peacekeepers leave संयुक्त राष्ट्र शांति सैनिकों के जाने के बाद भी पश्चिमी सहारा के शरणार्थियों को घर लौटने की आस

Western Sahara refugees still yearn for home as UN peacekeepers leave

Reuters
TINDOUF

At 51, Binina Mohamed is as old as the conflict that drove her from the Western Sahara region into a refugee camp in southern Algeria, where she has spent her life among tens of thousands of others facing a similar fate.

The confrontation over her native land, often described as Africa's longest-running territorial dispute, was brought back into focus this weekend by a UN Security Council spat that led to the end of a decades-old peacekeeping mission there.

The Western Sahara conflict pits Morocco, which considers the territory its own, against the Algeria-backed Polisario Front, a political and military organisation that has been seeking a separate state there since the departure of former colonial power Spain in 1976.

Peacekeepers have watched over the territory since 1991, when the UN brokered a ceasefire ending years of guerrilla warfare between the two sides.

Thousands of Sahrawis fled hostilities to the Tindouf area in southwestern Algeria, where the Polisario administers five refugee camps.

During a rare visit to the region for foreign media outlets, organised by the Polisario, Mohamed described how her daughters, now in their twenties and thirties, had never visited the region where she was from.

"I do not want them to reach the age of 50 without seeing their homeland," she told *Reuters*.

One of her daughters, Safia Al-Saleh, 33, said she hoped her own two children would have a different future.

"I want my children and my grandchildren to study and growup in their own country, not to grow up like us here, as refugees, with nothing," she said.

Camps at the centre

The uncertainty facing refugees such as Mohamed has become a central point of contention in the latest diplomatic battle over Western Sahara.

The dispute heated up last year when the UN Security Council backed Rabat's plan to give the region autonomy under Moroccan sovereignty as the "most feasible" way to resolve the conflict.



A view of a part of the refugee camp of Boudjdour in Tindouf, southern Algeria. REUTERS

After abstaining last year, Russia this year vetoed a US-drafted resolution that would have reaffirmed that position. When a competing Russian resolution was defeated, it left the UN mission without a renewal of its mandate.

In a speech at the council, Algeria's UN envoy defended the Polisario's stance and highlighted a decline in aid and the suffering of refugees in the camps.

Morocco's envoy in turn said the harsh conditions in the camps were the responsibility of Algeria, a longtime Russian ally, which he accused of denying the refugees their right toreturn home.

He urged Algiers to allow the UN to register the refugees, saying other nationalities were present there.

Algeria and the Polisario say over 160,000 live in the Tindouf refugee camps. UNHCR says it provides assistance to anestimated 90,000 of the "most vulnerable" refugees there.

Refugees' long wait

Morocco disputes both numbers, citing a lack of a UN census, and accuses the Polisario and Algeria of using Sahrawis aspolitical pawns, which Algiers denies.

As the dispute grinds on, Mohamed's family described daily problems in the camp, including access to water and the harsh climate. More than 80% of the camps' residents rely on humanitarian assistance to meet basic food needs, the World Food Programme said in a statement earlier this year.

Another of Mohamed's daughters, Aisha Salem, a 24- year-old fighter with the Polisario Front, said she wanted a different future for the next generation: "We don't want to live the wayour grandparents did, through displacement and deprivation," shesaid.

Mohamed echoed the sentiment.

"We want stability. We aretired of being refugees," she said. "The one who has no land hasno life," she added.

03N11. Western Sahara refugees still yearn for home as UN peacekeepers leave

संयुक्त राष्ट्र शांति सैनिकों के जाने के बाद भी पश्चिमी सहारा के शरणार्थियों को घर लौटने की आस

- At 51, Binina Mohamed is as old as the conflict that drove her from the Western Sahara region into a refugee camp in southern Algeria, where she has spent her life among tens of thousands of others facing a similar fate.
  51 वर्ष की बिनिना मोहम्मद की उम्र उतनी ही है जितना वह संघर्ष, जिसने उन्हें पश्चिमी सहारा क्षेत्र से निकालकर दक्षिणी अल्जीरिया के एक शरणार्थी शिविर में पहुँचा दिया। उन्होंने अपना जीवन वहाँ अपने जैसी स्थिति का सामना कर रहे हज़ारों लोगों के बीच बिताया है।
- The confrontation over her native land, often described as Africa's longest-running territorial dispute, was brought back into focus this weekend by a UN Security Council spat that led to the end of a decades-old peacekeeping mission there.
  उनकी मातृभूमि को लेकर यह संघर्ष—जिसे अक्सर अफ्रीका का सबसे लंबा क्षेत्रीय विवाद कहा जाता है—इस सप्ताहांत फिर चर्चा में आया। संयुक्त राष्ट्र सुरक्षा परिषद में हुए मतभेद के कारण वहाँ दशकों पुराना शांति मिशन समाप्त हो गया।
- The **Western Sahara conflict** pits Morocco, which considers the territory its own, against the Algeria-backed **Polisario Front**, a political and military organisation that has been seeking a separate state there since the departure of former colonial power Spain in 1976.
  पश्चिमी सहारा संघर्ष में एक ओर मोरक्को है, जो इस क्षेत्र को अपना मानता है, और दूसरी ओर अल्जीरिया-समर्थित **पोलिसारियो फ्रंट** है—एक राजनीतिक और सैन्य संगठन, जो 1976 में पूर्व औपनिवेशिक शक्ति स्पेन के जाने के बाद से वहाँ अलग राज्य की माँग कर रहा है।
- **Peacekeepers** have watched over the territory since 1991, when the UN brokered a ceasefire ending years of guerrilla warfare between the two sides.
  1991 से **शांति सैनिक** इस क्षेत्र की निगरानी कर रहे हैं। उसी वर्ष संयुक्त राष्ट्र ने दोनों पक्षों के बीच कई वर्षों से चल रहे छापामार युद्ध को समाप्त करने के लिए संघर्षविराम कराया था।
- Thousands of Sahrawis fled hostilities to the Tindouf area in southwestern Algeria, where the Polisario administers five refugee camps.
  हज़ारों सहारावी लोग लड़ाई से बचकर दक्षिण-पश्चिमी अल्जीरिया के टिंडूफ़ क्षेत्र में चले गए, जहाँ पोलिसारियो पाँच शरणार्थी शिविरों का प्रशासन चलाता है।

Polisario
पोलिसारियो

- During a rare visit to the region for foreign media outlets, organised by the Polisario, Mohamed described how her daughters, now in their twenties and thirties, had never visited the region where she was from.
  विदेशी मीडिया संस्थानों के लिए पोलिसारियो द्वारा आयोजित क्षेत्र की एक दुर्लभ यात्रा के दौरान, मोहम्मद ने बताया कि उनकी बेटियाँ—जो अब 20 और 30 वर्ष की हैं—कभी उस क्षेत्र में नहीं गईं जहाँ से वह आती हैं।
- "I do not want them to reach the age of 50 without seeing their homeland," she told Reuters.
  उन्होंने रॉयटर्स से कहा, "मैं नहीं चाहती कि वे अपनी मातृभूमि देखे बिना 50 वर्ष की हो जाएँ।"
- One of her daughters, Safia Al-Saleh, 33, said she hoped her own two children would have a different future.
  उनकी एक बेटी, 33 वर्षीय सफ़िया अल-सालेह ने कहा कि उन्हें उम्मीद है कि उनके अपने दोनों बच्चों का भविष्य अलग होगा।
- "I want my children and my grandchildren to study and grow up in their own country, not to grow up like us here, as refugees, with nothing," she said.
  उन्होंने कहा, "मैं चाहती हूँ कि मेरे बच्चे और नाती-पोते अपने देश में पढ़ें और बड़े हों; वे यहाँ हमारी तरह शरणार्थी बनकर और बिना किसी सहारे के बड़े न हों।"

Camps at the centre
शिविर विवाद के केंद्र में

- The uncertainty facing refugees such as Mohamed has become a central point of contention in the latest diplomatic battle over Western Sahara.
  मोहम्मद जैसे शरणार्थियों के सामने मौजूद अनिश्चितता पश्चिमी सहारा को लेकर हालिया कूटनीतिक संघर्ष का एक केंद्रीय मुद्दा बन गई है।
- The dispute heated up last year when the UN Security Council backed Rabat's plan to give the region autonomy under Moroccan sovereignty as the "most feasible" way to resolve the conflict.
  पिछले वर्ष विवाद तब और गहरा गया, जब संयुक्त राष्ट्र सुरक्षा परिषद ने संघर्ष सुलझाने के "सबसे व्यावहारिक" तरीके के रूप में मोरक्को की संप्रभुता के तहत इस क्षेत्र को स्वायत्तता देने की रबात की योजना का समर्थन किया।
- After abstaining last year, Russia this year vetoed a U.S.-drafted resolution that would have reaffirmed that position.
  पिछले वर्ष मतदान से दूर रहने के बाद, रूस ने इस वर्ष अमेरिका द्वारा तैयार उस प्रस्ताव पर वीटो कर दिया, जो उस रुख़ की फिर से पुष्टि करता।
- When a competing Russian resolution was defeated, it left the UN mission without a renewal of its mandate.
  रूस का वैकल्पिक प्रस्ताव पराजित होने के बाद संयुक्त राष्ट्र मिशन का कार्यादेश नवीनीकृत नहीं हो सका।
- In a speech at the council, Algeria's UN envoy defended the Polisario's stance and highlighted a decline in aid and the suffering of refugees in the camps.
  सुरक्षा परिषद में दिए गए भाषण में अल्जीरिया के संयुक्त राष्ट्र दूत ने पोलिसारियो के रुख़ का बचाव किया और सहायता में आई कमी तथा शिविरों में शरणार्थियों की पीड़ा का उल्लेख किया।
- Morocco's envoy in turn said the harsh conditions in the camps were the responsibility of Algeria, a longtime Russian ally, which he accused of denying the refugees their right to return home.
  इसके जवाब में मोरक्को के दूत ने कहा कि शिविरों की कठिन परिस्थितियों के लिए अल्जीरिया ज़िम्मेदार है। उन्होंने रूस के लंबे समय से सहयोगी रहे अल्जीरिया पर शरणार्थियों को घर लौटने के अधिकार से वंचित करने का आरोप लगाया।
- He urged Algiers to allow the UN to register the refugees, saying other nationalities were present there.

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उन्होंने अल्जीयर्स से शरणार्थियों का पंजीकरण करने के लिए संयुक्त राष्ट्र को अनुमति देने का आग्रह किया और कहा कि वहाँ अन्य राष्ट्रीयताओं के लोग भी मौजूद हैं।

- Algeria and the Polisario say over 160,000 live in the Tindouf refugee camps.
  अल्जीरिया और पोलिसारियो का कहना है कि टिंडूफ़ के शरणार्थी शिविरों में 1,60,000 से अधिक लोग रहते हैं।
- UNHCR says it provides assistance to an estimated 90,000 of the "most vulnerable" refugees there.
  संयुक्त राष्ट्र शरणार्थी उच्चायुक्त (UNHCR) का कहना है कि वह वहाँ अनुमानित 90,000 "सबसे असुरक्षित" शरणार्थियों को सहायता देता है।

Refugees' long wait
शरणार्थियों का लंबा इंतज़ार

- Morocco disputes both numbers, citing a lack of a UN census, and accuses the Polisario and Algeria of using Sahrawis as political pawns, which Algiers denies.
  मोरक्को संयुक्त राष्ट्र की जनगणना न होने का हवाला देते हुए दोनों आँकड़ों पर सवाल उठाता है और पोलिसारियो तथा अल्जीरिया पर सहारावी लोगों को राजनीतिक मोहरे की तरह इस्तेमाल करने का आरोप लगाता है। अल्जीयर्स इस आरोप से इनकार करता है।
- As the dispute grinds on, Mohamed's family described daily problems in the camp, including access to water and the harsh climate.
  विवाद लंबा खिंचने के बीच, मोहम्मद के परिवार ने शिविर में रोज़मर्रा की समस्याओं के बारे में बताया, जिनमें पानी तक पहुँच और कठोर जलवायु शामिल हैं।
- More than 80% of the camps' residents rely on humanitarian assistance to meet basic food needs, the World Food Programme said in a statement earlier this year.
  विश्व खाद्य कार्यक्रम ने इस वर्ष की शुरुआत में एक बयान में कहा कि शिविरों के 80% से अधिक निवासी भोजन की बुनियादी ज़रूरतें पूरी करने के लिए मानवीय सहायता पर निर्भर हैं।
- Another of Mohamed's daughters, Aisha Salem, a 24-year-old fighter with the Polisario Front, said she wanted a different future for the next generation: "We don't want to live the way our grandparents did, through displacement and deprivation," she said.
  मोहम्मद की एक और बेटी, पोलिसारियो फ्रंट की 24 वर्षीय लड़ाकू आयशा सलेम ने कहा कि वह अगली पीढ़ी के लिए अलग भविष्य चाहती हैं: "हम अपने दादा-दादी की तरह विस्थापन और अभाव में जीवन नहीं बिताना चाहते," उन्होंने कहा।
- Mohamed echoed the sentiment.
  मोहम्मद ने भी यही भावना दोहराई।
- "We want stability.
  "हम स्थिरता चाहते हैं।
- We are tired of being refugees," she said.
  हम शरणार्थी बने रहने से थक चुके हैं," उन्होंने कहा।
- "The one who has no land has no life," she added.
  उन्होंने आगे कहा, "जिसके पास अपनी ज़मीन नहीं, उसके पास जीवन नहीं।"

PATRIOTIC IAS

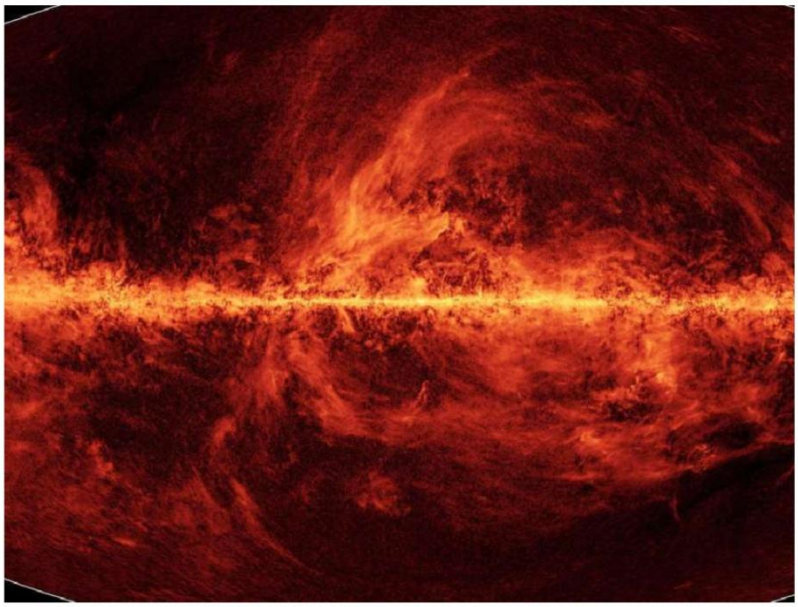
GS Paper III: Science and Technology	03 November 2026
TOPICS COVERED	
03N11	Milky Way grew by devouring galaxies, leaving ghost stars आकाशगंगा ने अन्य आकाशगंगाओं को निगलकर अपना विस्तार किया, जिससे तारों के अवशेष पीछे छूट गए।

03N11	New technique uses light to spot deepfakes in seconds नई तकनीक प्रकाश से कुछ ही सेकंड में डीपफेक की पहचान करती है।
03N11	How smoking sets the stage for lung cancer, glimpsed in new study नए अध्ययन से मिली झलक: धूम्रपान कैसे फेफड़ों के कैंसर की ज़मीन तैयार करता है

Milky Way grew by devouring galaxies, leaving ghost stars

Galactic archaeologists are using precise measures and larger sample sizes afforded by new missions to tease apart minute differences between groups of stars, revealing the history of Milky Way going back around 12 billion years; age, chemistry, and motion reveal different aspects about stars

[redacted]
Siddhant Pusdekar
LONDON



The Milky Way galaxy is ablaze with dust in this all-sky map from 'Planck', a European Space Agency mission with important NASA contributions. The towers of fiery colours are actually dust in the galaxy and beyond that has been polarised. ESA/NASA/JPL-CALTECH

There have always been stories about them. Australian Aboriginal tales tell of an old couple called the Jukara, while for Chile's Mapuche people they are Rvganko or water ponds. To modern astronomers, they are the Small and Large Magellanic clouds, two of the closest galaxies to us that are in the process of being swallowed by the Milky Way.

They are evidence of a kind of snowball effect that characterises the formation and evolution of galaxies, which scientists believe are the result of a series of violent collisions. As galaxies fall into one another, the smaller ones are ripped apart by tidal forces of the larger, leaving behind streams and clusters of stars that don't move in lockstep with the rest of the galaxy. They also stand out for their chemical compositions, which allow astronomers to group stars that were born together and piece back their rough ages.

And together, age, chemistry, and motion tell astronomers different things about stars. Galactic archaeologists use precise measures and larger sample sizes afforded by new missions to tease apart minute differences between groups of stars, revealing the history of the Milky Way going back almost 12 billion years.

First of its kind

In early September, Vasily Belokurov, Amina Helmi, and Rodrigo Ibata won the Kavli Award for complementary discoveries of some of the galaxy's major collisions.

It began with a chance observation. Over three decades ago, when Dr. Ibata, of the University of Strasbourg, turned his attention to the central bulge of the galaxy's disc, he noticed some stars slightly off-centre moving in a peculiar way.

Everything in the galaxy has a shared direction of motion and velocity, but these particular stars stood out and all seemed to be moving in concert. After a year of repeated measurements, Dr. Ibata was left with the only hypothesis that made sense: that the group of stars were part of a much smaller galaxy, the Sagittarius dwarf, that the Milky Way had absorbed.

Although researchers had suspected that the galaxy is littered with remnants of ancient collisions, the discovery – the first of its kind – kickstarted a search for more. Galaxies that were absorbed earlier would be harder to see, because, unlike Sagittarius, which merged only six billion years ago, they might not be intact.

Gaia-Enceladus

As part of her PhD in the 1990s, Dr. Helmi, now at the University of Groningen, developed models of this destruction and predicted that as smaller galaxies are ripped apart by larger ones, they leave behind a stream of stars that should be visible.

In 1999, by applying those models on data from the European Space Agency's (ESA) Hipparcos mission, Dr. Helmi *et al.* analysed the three-dimensional motion of 97 stars around the sun. They found seven had a different orbit from the rest, suggesting they come from outside the galaxy.

But this was a small sample. If the Milky Way formed by cannibalising many smaller galaxies, the firmament should be littered with streams. To see them, researchers would need to tease apart the motion dynamics of thousands of stars with greater precision.

Dr. Helmi waited 20 years until the ESA Gaia mission released its second dataset, looking at almost the whole galaxy. In 2018, Dr. Helmi *et al.* used these measurements to find a large fraction of stars in our neighbourhood that move counterclockwise, instead of the clockwise motion of the rest of the galaxy.

The team combined photometry data on colour and brightness from Gaia and spectroscopy obtained from APO Galactic Evolution Experiment to estimate the ages and chemical composition of these stars. Finally, they grouped the stars that were born together.

They also developed a model that fit the relationship between the colour and luminosity of these groups of stars, to reveal their age. Together, the results suggested these stars were born 10-12 billion years ago in a different galaxy, which they called Gaia-Enceladus.

First major merger

Using the chemical compositions, the team also calculated the rate of star formation and the mass of this galaxy before it crashed with the Milky Way. As opposed to the many smaller collisions Dr. Helmi expected to see, the collision with Gaia-Enceladus, which occurred about 10 billion years ago, must have been large enough to alter the Milky Way's shape, she said. There have been even older collisions, however. In an August 2026 paper, researchers confirmed that around 12 billion years ago, a galaxy called Low-energy-Kraken-Heracles (LKH) collided with the Milky Way. LKH sits in our galaxy's central bulge, which contains the oldest stars going back to the galaxy's creation. But stardust obscures the view.

Another problem with studying such old collisions is that the galaxies were still young, making it harder to detect the divergence in the evolution of their stellar systems, which would be apparent in the stars that came from them.

Instead of focusing on individual stars, the researchers studied 39 globular clusters, groups of about a million stars that are born together and behaved in the same way. They also homogenised the models they used to calculate the ages of stars, because different models can produce results that diverge by as much as 2 billion years, said Davide Massari of the National Institute for Astrophysics at Bologna, who led the work.

'Amazing decade'

By applying these theoretical models about age-dependent dynamics and element content to their data, the researchers determined that 12 of these globular clusters are not from the Milky Way and were absorbed 1.8 billion years before Gaia-Enceladus. At about 12 billion years, this might be the first major merger the Milky Way experienced, Dr. Massari said. While data from the Gaia mission are resolving the history of the galaxy, they also raise new questions and are telling researchers where to point new tools.

How bits of galaxies move after being accreted by the Milky Way may not be uniform, making it challenging to tell whether some seemingly foreign objects have a common origin. A recent reanalysis suggested that the globular cluster omega-Centauri, once thought to be a dwarf galaxy absorbed by the Milky Way, may be the nucleus of Gaia-Enceladus. But the data are not conclusive: the researchers do not fully understand how omega-Centauri's interaction with the Milky Way's central bulge might have changed its motion.

New projects are coming online to dig deeper. 4MOST, a multi-object spectroscopic survey instrument in Paranal, Chile, will soon start surveying the Southern Sky, probing the Magellanic clouds, Sagittarius, and other previously identified galaxies. The MOONS telescope will also detect infrared light coming from the galactic bulge, which escapes from the center more easily, said Ása Skúladóttir of the University of Florence.

"The last 10 years have been amazing," Dr. Skúladóttir, who has a project associated with 4MOST, added. "But I genuinely believe that the next 10 years are going to be even more amazing because there's so much data coming, and people are really getting invested in this field."

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03N11. Milky Way grew by devouring galaxies, leaving ghost stars
आकाशगंगा ने अन्य आकाशगंगाओं को निगलकर अपना विस्तार किया, जिससे तारों के अवशेष पीछे छूट गए।

- There have always been stories about them.
  इनके बारे में सदैव से कहानियाँ प्रचलित रही हैं।
- Australian Aboriginal tales tell of an old couple called the Jukara, while for Chile's Mapuche people they are Rvganko or water ponds.
  ऑस्ट्रेलिया के आदिवासी समुदायों की लोककथाओं में इन्हें जुकारा (Jukara) नामक एक वृद्ध दंपति के रूप में वर्णित किया गया है, जबकि चिली के मापुचे समुदाय के लिए ये रवगांको (Rvganko) अथवा जलकुंड हैं।
- To modern astronomers, they are the **Small and Large Magellanic Clouds**, two of the closest galaxies to us that are in the process of being swallowed by the Milky Way.
  आधुनिक खगोलविदों के लिए ये **लघु एवं विशाल मैगेलैनिक बादल** हैं, जो पृथ्वी के निकटतम आकाशगंगाओं में से दो हैं और वर्तमान में आकाशगंगा द्वारा निगले जाने की प्रक्रिया में हैं।



- They are evidence of a kind of **snowball effect** that characterises the formation and evolution of galaxies, which scientists believe are the result of a series of violent collisions.
  ये एक प्रकार के **हिमगोला प्रभाव** के प्रमाण हैं, जो आकाशगंगाओं के निर्माण एवं विकास की विशेषता है और जिसके बारे में वैज्ञानिकों का मानना है कि यह हिंसक टक्करों की एक श्रृंखला का परिणाम है।
- As galaxies fall into one another, the smaller ones are ripped apart by **tidal forces** of the larger, leaving behind streams and clusters of stars that don't move in lockstep with the rest of the galaxy.
  जब आकाशगंगाएँ एक-दूसरे में समाहित होती हैं, तो बड़ी आकाशगंगाओं के **ज्वारीय बलों** से छोटी आकाशगंगाएँ विखंडित हो जाती हैं। इससे तारों की धाराएँ और समूह पीछे छूट जाते हैं, जो आकाशगंगा के बाकी तारों के साथ तालमेल में गति नहीं करते।
- They also stand out for their **chemical compositions**, which allow astronomers to group stars that were born together and piece back their rough ages.
  वे अपनी **रासायनिक संरचना** के कारण भी विशिष्ट होती हैं, जो खगोलविदों को एक साथ जन्मे तारों का समूह बनाने और उनकी अनुमानित आयु का पुनर्निर्धारण करने में मदद करती है।
- And together, age, chemistry, and motion tell astronomers different things about stars.
  इस प्रकार, आयु, रासायनिक संरचना और गति—ये तीनों मिलकर खगोलविदों को तारों के बारे में अलग-अलग जानकारियाँ देते हैं।
- **Galactic archaeologists** use precise measures and larger sample sizes afforded by new missions to tease apart minute differences between groups of stars, revealing the history of the Milky Way going back almost 12 billion years.
  आकाशगंगीय पुरातत्त्वविद नए अंतरिक्ष अभियानों से उपलब्ध सटीक मापों और बड़े नमूना आकारों का उपयोग तारों के समूहों के बीच सूक्ष्म अंतरों की पहचान करने के लिए करते हैं। इससे लगभग 12 अरब वर्ष पुरानी आकाशगंगा के इतिहास का पता चलता है।

First of its kind
अपनी तरह की पहली खोज

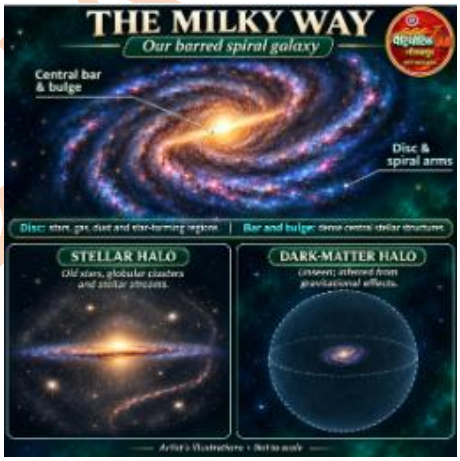
- In early September, Vasily Belokurov, Amina Helmi, and Rodrigo Ibata won the **Kavli Award** for complementary discoveries of some of the galaxy's major collisions.
  सितंबर की शुरुआत में, वासिली बेलोकुरोव, अमीना हेल्मी और रोड्रिगो इबाता को आकाशगंगा की कुछ प्रमुख टक्करों से संबंधित परस्पर पूरक खोजों के लिए **कावली पुरस्कार** मिला।
- It began with a chance observation.
  इसकी शुरुआत एक आकस्मिक अवलोकन से हुई।
- Over three decades ago, when Dr. Ibata, of the University of Strasbourg, turned his attention to the central bulge of the galaxy's disc, he noticed some stars slightly off-centre moving in a peculiar way.
  तीन दशक से भी अधिक समय पहले, जब स्ट्रासबर्ग विश्वविद्यालय के डॉ. इबाता ने आकाशगंगा की चकती के केंद्रीय उभार पर ध्यान दिया, तो उन्होंने केंद्र से थोड़ा हटकर स्थित कुछ तारों को असामान्य तरीके से गति करते देखा।
- Everything in the galaxy has a shared direction of motion and velocity, but these particular stars stood out and all seemed to be moving in concert.
  आकाशगंगा में सभी पिंडों की गति की दिशा और वेग सामान्यतः एक-दूसरे के अनुरूप होते हैं, लेकिन ये तारे अलग दिखाई दिए और ऐसा लगा कि वे सभी एक समन्वित ढंग से गति कर रहे थे।
- After a year of repeated measurements, Dr. Ibata was left with the only hypothesis that made sense: that the group of stars were part of a much smaller galaxy, the **Sagittarius dwarf**, that the Milky Way had absorbed.
  एक वर्ष तक बार-बार माप करने के बाद, डॉ. इबाता के सामने एकमात्र तार्किक परिकल्पना यह थी कि तारों का यह समूह एक बहुत छोटी आकाशगंगा—**धनु बौनी आकाशगंगा**—का हिस्सा था, जिसे आकाशगंगा ने अपने भीतर समाहित कर लिया था।
- Although researchers had suspected that the galaxy is littered with remnants of ancient collisions, the discovery — the first of its kind — kickstarted a search for more.
  हालाँकि शोधकर्ताओं को पहले से संदेह था कि आकाशगंगा में प्राचीन टक्करों के अवशेष बिखरे हुए हैं, लेकिन इस अपनी तरह की पहली खोज ने ऐसे और अवशेषों की तलाश शुरू करने का मार्ग प्रशस्त किया।
- Galaxies that were absorbed earlier would be harder to see, because, unlike Sagittarius, which merged only six billion years ago, they might not be intact.
  पहले समाहित हुई आकाशगंगाओं को देख पाना अधिक कठिन होता, क्योंकि धनु आकाशगंगा के विपरीत—जिसका विलय केवल छह अरब वर्ष पहले हुआ था—वे अपनी मूल संरचना में सुरक्षित नहीं रही होंगी।

Gaia-Enceladus
गैया-एन्सेलाडस

- As part of her PhD in the 1990s, Dr. Helmi, now at the University of Groningen, developed models of this destruction and predicted that as smaller galaxies are ripped apart by larger ones, they leave behind a stream of stars that should be visible.
  1990 के दशक में अपनी पीएचडी के हिस्से के रूप में, डॉ. हेल्मी ने—जो अब ग्रोनिंगन विश्वविद्यालय में कार्यरत हैं—इस विखंडन के मॉडल विकसित किए। उन्होंने भविष्यवाणी की कि जब छोटी आकाशगंगाएँ बड़ी आकाशगंगाओं द्वारा विखंडित होती हैं, तो वे तारों की ऐसी धाराएँ पीछे छोड़ती हैं जिन्हें देखा जा सकता है।
- In 1999, by applying those models on data from the European Space Agency's (ESA) Hipparcos mission, Dr. Helmi et al. analysed the three-dimensional motion of 97 stars around the sun.
  1999 में, यूरोपीय अंतरिक्ष एजेंसी (ESA) के हिप्पार्कोस मिशन के आँकड़ों पर इन मॉडलों को लागू करके डॉ. हेल्मी और उनके सहयोगियों ने सूर्य के आसपास स्थित 97 तारों की त्रि-आयामी गति का विश्लेषण किया।
- They found seven had a different orbit from the rest, suggesting they come from outside the galaxy.
  उन्होंने पाया कि उनमें से सात तारों की कक्षा बाकी तारों से अलग थी, जिससे संकेत मिला कि वे इस आकाशगंगा के बाहर से आए थे।

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- But this was a small sample.
  लेकिन यह एक छोटा नमूना था।
- If the Milky Way formed by cannibalising many smaller galaxies, the firmament should be littered with streams.
  यदि आकाशगंगा का निर्माण अनेक छोटी आकाशगंगाओं को अपने भीतर समाहित करके हुआ है, तो आकाश में तारों की ऐसी अनेक धाराएँ बिखरी हुई होनी चाहिए।
- To see them, researchers would need to tease apart the **motion dynamics** of thousands of stars with greater precision.
  उन्हें देखने के लिए शोधकर्ताओं को हज़ारों तारों की **गतिशीलता** का अधिक सटीकता से पृथक्करण और विश्लेषण करना आवश्यक था।
- Dr. Helmi waited 20 years until the ESA Gaia mission released its second dataset, looking at almost the whole galaxy.
  डॉ. हेल्मी ने 20 वर्षों तक प्रतीक्षा की, जब तक कि ESA के गैया मिशन ने अपना दूसरा आँकड़ा-संग्रह जारी नहीं किया, जिसमें लगभग पूरी आकाशगंगा का अध्ययन किया गया था।



- In 2018, Dr. Helmi et al. used these measurements to find a large fraction of stars in our neighbourhood that move counterclockwise, instead of the clockwise motion of the rest of the galaxy.
  2018 में, डॉ. हेल्मी और उनके सहयोगियों ने इन मापों का उपयोग करके हमारे आसपास के तारों के एक बड़े समूह की पहचान की, जो आकाशगंगा के बाकी तारों की दक्षिणावर्त गति के बजाय वामावर्त गति करते हैं।
- The team combined **photometry data** on colour and brightness from Gaia and **spectroscopy** obtained from APO Galactic Evolution Experiment to estimate the ages and chemical composition of these stars.
  इस दल ने इन तारों की आयु और रासायनिक संरचना का अनुमान लगाने के लिए गैया से प्राप्त रंग एवं चमक संबंधी **प्रकाशमितीय आँकड़ों** को APO गैलेक्टिक इवोल्यूशन एक्सपेरिमेंट से प्राप्त **वर्णक्रमीय आँकड़ों** के साथ जोड़ा।
- Finally, they grouped the stars that were born together.
  अंततः, उन्होंने एक साथ जन्मे तारों के समूह बनाए।
- They also developed a model that fit the relationship between the colour and luminosity of these groups of stars, to reveal their age.
  उन्होंने एक ऐसा मॉडल भी विकसित किया जो तारों के इन समूहों के रंग और दीप्तिमानता के बीच संबंध का निर्धारण करता था, ताकि उनकी आयु का पता लगाया जा सके।
- Together, the results suggested these stars were born 10-12 billion years ago in a different galaxy, which they called Gaia-Enceladus.
  समग्र परिणामों से संकेत मिला कि इन तारों का जन्म 10–12 अरब वर्ष पहले किसी दूसरी आकाशगंगा में हुआ था, जिसे उन्होंने गैया-एन्सेलाडस नाम दिया।

First major merger
पहला प्रमुख विलय

- Using the chemical compositions, the team also calculated the rate of star formation and the mass of this galaxy before it crashed with the Milky Way.
  रासायनिक संरचना का उपयोग करके इस दल ने आकाशगंगा से टकराने से पहले उस आकाशगंगा में तारा निर्माण की दर और उसके द्रव्यमान की भी गणना की।
- As opposed to the many smaller collisions Dr. Helmi expected to see, the collision with Gaia-Enceladus, which occurred about 10 billion years ago, must have been large enough to alter the Milky Way's shape, she said.

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डॉ. हेल्मी ने कहा कि जिन अनेक छोटी टक्करों की उन्होंने अपेक्षा की थी, उनके विपरीत, लगभग 10 अरब वर्ष पहले गैया-एन्सेलाडस के साथ हुई टक्कर इतनी बड़ी रही होगी कि उसने आकाशगंगा का आकार बदल दिया होगा।

- There have been even older collisions, however.
  हालाँकि, इससे भी अधिक प्राचीन टक्करें हुई हैं।
- In an August 2026 paper, researchers confirmed that around 12 billion years ago, a galaxy called **Low-energy-Kraken-Heracles (LKH)** collided with the **Milky Way**.
  अगस्त 2026 के एक शोधपत्र में शोधकर्ताओं ने पुष्टि की कि लगभग 12 अरब वर्ष पहले **लो-एनर्जी-क्रैकन-हेराक्लीज़ (LKH)** नामक आकाशगंगा की टक्कर आकाशगंगा से हुई थी।
- LKH sits in our galaxy's central bulge, which contains the oldest stars going back to the galaxy's creation.
  LKH हमारी आकाशगंगा के केंद्रीय उभार में स्थित है, जहाँ आकाशगंगा के निर्माण के समय से मौजूद सबसे प्राचीन तारे हैं।
- But stardust obscures the view.
  लेकिन तारकीय धूल के कारण दृश्य स्पष्ट नहीं हो पाता।
- Another problem with studying such old collisions is that the galaxies were still young, making it harder to detect the divergence in the evolution of their stellar systems, which would be apparent in the stars that came from them.
  इतनी प्राचीन टक्करों के अध्ययन में एक अन्य समस्या यह है कि उस समय आकाशगंगाएँ अभी युवा थीं। इससे उनकी तारकीय प्रणालियों के विकास में आए अंतर को पहचानना कठिन हो जाता है, जबकि ये अंतर उनसे उत्पन्न तारों में स्पष्ट दिख सकते हैं।
- Instead of focusing on individual stars, the researchers studied 39 **globular clusters**, groups of about a million stars that are born together and behaved in the same way.
  व्यक्तिगत तारों पर ध्यान केंद्रित करने के बजाय, शोधकर्ताओं ने 39 **गोलाकार तारागुच्छों** का अध्ययन किया। इनमें लगभग दस लाख तारे होते हैं, जो एक साथ जन्म लेते हैं और समान ढंग से व्यवहार करते हैं।
- They also homogenised the models they used to calculate the ages of stars, because different models can produce results that diverge by as much as 2 billion years, said Davide Massari of the National Institute for Astrophysics at Bologna, who led the work.
  इस कार्य का नेतृत्व करने वाले बोलोन्या स्थित राष्ट्रीय खगोलभौतिकी संस्थान के डेविडे मस्सारी ने कहा कि उन्होंने तारों की आयु की गणना के लिए इस्तेमाल किए जाने वाले मॉडलों में एकरूपता भी स्थापित की, क्योंकि अलग-अलग मॉडल के परिणामों में 2 अरब वर्ष तक का अंतर हो सकता है।

'Amazing decade'
'अद्भुत दशक'

- By applying these theoretical models about age-dependent dynamics and element content to their data, the researchers determined that 12 of these globular clusters are not from the Milky Way and were absorbed 1.8 billion years before Gaia-Enceladus.
  आयु-निर्भर गतिशीलता और तत्वों की मात्रा से संबंधित इन सैद्धांतिक मॉडलों को अपने आँकड़ों पर लागू करके शोधकर्ताओं ने निर्धारित किया कि इन गोलाकार तारागुच्छों में से 12 आकाशगंगा से नहीं आए थे और गैया-एन्सेलाडस के समाहित होने से 1.8 अरब वर्ष पहले ही आकाशगंगा में समा गए थे।
- At about 12 billion years, this might be the first major merger the Milky Way experienced, Dr. Massari said.
  डॉ. मस्सारी ने कहा कि लगभग 12 अरब वर्ष पहले हुई यह घटना संभवतः आकाशगंगा का पहला प्रमुख विलय हो सकती है।
- While data from the **Gaia mission** are resolving the history of the galaxy, they also raise new questions and are telling researchers where to point new tools.

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जहाँ एक ओर **गैया मिशन** के आँकड़े आकाशगंगा का इतिहास स्पष्ट कर रहे हैं, वहीं दूसरी ओर वे नए सवाल भी उठा रहे हैं और शोधकर्ताओं को बता रहे हैं कि नए उपकरणों को किस दिशा में लगाना चाहिए।

- How bits of galaxies move after being **accreted** by the Milky Way may not be uniform, making it challenging to tell whether some seemingly foreign objects have a common origin.
आकाशगंगा द्वारा अपने भीतर **समाहित** किए जाने के बाद आकाशगंगाओं के अवशेष किस तरह गति करते हैं, यह एकसमान नहीं हो सकता। इससे यह तय करना चुनौतीपूर्ण हो जाता है कि बाहर से आए हुए लगने वाले कुछ पिंडों का उद्गम एक ही है या नहीं।
- A recent reanalysis suggested that the **globular cluster omega-Centauri**, once thought to be a dwarf galaxy absorbed by the Milky Way, may be the nucleus of Gaia-Enceladus.
हाल के एक पुनर्विश्लेषण से संकेत मिला कि **ओमेगा सेंटॉरी नामक गोलाकार तारागुच्छ**, जिसे कभी आकाशगंगा द्वारा समाहित की गई बौनी आकाशगंगा माना जाता था, संभवतः गैया-एन्सेलाडस का केंद्रक हो सकता है।
- But the data are not conclusive: the researchers do not fully understand how omega-Centauri's interaction with the Milky Way's central bulge might have changed its motion.
लेकिन आँकड़े निर्णायक नहीं हैं: शोधकर्ता अभी पूरी तरह नहीं समझ पाए हैं कि आकाशगंगा के केंद्रीय उभार के साथ ओमेगा सेंटॉरी की अंतःक्रिया ने उसकी गति को किस तरह बदला होगा।
- New projects are coming online to dig deeper.
इस विषय का अधिक गहराई से अध्ययन करने के लिए नई परियोजनाएँ शुरू हो रही हैं।
- **4MOST**, a multi-object spectroscopic survey instrument in Paranal, Chile, will soon start surveying the Southern Sky, probing the Magellanic Clouds, Sagittarius, and other previously identified galaxies.
चिली के पारानाल में स्थित बहु-वस्तु वर्णक्रमीय सर्वेक्षण उपकरण **4MOST** जल्द ही दक्षिणी आकाश का सर्वेक्षण शुरू करेगा। इसके तहत मैगेलैनिक बादलों, धनु आकाशगंगा और पहले से पहचानी गई अन्य आकाशगंगाओं की जाँच की जाएगी।
- The **MOONS telescope** will also detect infrared light coming from the galactic bulge, which escapes from the center more easily, said Ása Skúladóttir of the University of Florence.
फ्लोरेंस विश्वविद्यालय की आसा स्कुलाडोटिर ने कहा कि **MOONS दूरबीन** आकाशगंगा के केंद्रीय उभार से आने वाले अवरक्त प्रकाश का भी पता लगाएगी, क्योंकि यह प्रकाश केंद्र से अपेक्षाकृत आसानी से बाहर निकल जाता है।
- "The last 10 years have been amazing," Dr. Skúladóttir, who has a project associated with 4MOST, added.
4MOST से जुड़ी एक परियोजना पर काम कर रहीं डॉ. स्कुलाडोटिर ने आगे कहा, "पिछले 10 वर्ष अद्भुत रहे हैं।"
- "But I genuinely believe that the next 10 years are going to be even more amazing because there's so much data coming, and people are really getting invested in this field."
"लेकिन मेरा सचमुच मानना है कि अगले 10 वर्ष इससे भी अधिक अद्भुत होंगे, क्योंकि बहुत अधिक आँकड़े आने वाले हैं और लोग वास्तव में इस क्षेत्र में रुचि ले रहे हैं तथा निवेश कर रहे हैं।"

Tidal forces are differences in gravity's pull across an object.

- When a smaller galaxy approaches a larger one, the larger galaxy pulls **more strongly on the nearer side** of the smaller galaxy than on its farther side. This uneven pull **stretches and distorts the smaller galaxy**.

- Think of a soft ball being pulled more strongly at one end than the other—it becomes stretched.
- If the difference in gravitational pull is strong enough, some stars become detached from the smaller galaxy. They spread along their orbits, forming **long streams of stars** around the larger galaxy. These stars can retain a distinct pattern of movement, rather than immediately moving like its other stars.
- **The same basic effect produces Earth's ocean tides:** the Moon's gravity pulls unequally across Earth. In galaxies, the stretching acts on stars instead of ocean water.

Kavli Prize

- The **Kavli Prize**, sometimes informally called the Kavli Award, is an international honour recognising major scientific breakthroughs.
- It was first awarded in **2008** and is presented **every two years** in three fields:

Field	Basic subject
Astrophysics	Stars, galaxies, planets and the physical nature of the universe.
Nanoscience	Matter and its properties at extremely small scales, typically billionths of a metre.
Neuroscience	The brain, nervous system and how they function.

- Each field carries a **US$1 million prize**, which may be shared among recipients.
- The prize is a partnership between the **Norwegian Academy of Science and Letters**, the **Kavli Foundation** and Norway's **Ministry of Education and Research**.
- It is **separate from the Nobel Prize**. In astrophysics, it recognises discoveries that significantly advance understanding of the universe.

Sagittarius

Sagittarius Constellation

- **Sagittarius**, meaning **"the Archer,"** is a constellation—a formally defined region of the sky.
- Its stars appear to form a pattern when viewed from Earth, but they may lie at very different distances and need not belong to one physical group.
- The **centre of the Milky Way lies in the direction of Sagittarius**. This describes our line of sight from Earth.

Sagittarius Dwarf Galaxy

- In discussions of **galactic mergers and tidal streams**, "Sagittarius" usually means the **Sagittarius dwarf spheroidal galaxy**.
- Discovered in **1994**, it is a small satellite galaxy orbiting and interacting with the Milky Way.
- The Milky Way's **uneven gravitational pull—tidal forces—strips stars from it**, creating extended stellar streams.

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- These streams help astronomers reconstruct the Milky Way's history of absorbing smaller galaxies.
- It should not be confused with the separate **Sagittarius Dwarf Irregular Galaxy**, also called **SagDIG**.

Sagittarius A*

- **Sagittarius A***, pronounced **"Sagittarius A-star,"** is the name associated with the **supermassive black hole at the Milky Way's centre**.
- It is neither the Sagittarius constellation nor the Sagittarius dwarf galaxy.

Hipparcos Mission

- **Hipparcos** was a **European Space Agency (ESA)** satellite launched on **8 August 1989**.
- It was a pioneering space mission dedicated to **astrometry—the precise measurement of stars' positions and movements**.
- Its principal scientific observations were collected between **November 1989 and March 1993**.
- Its name stands for **High Precision Parallax Collecting Satellite**, while also recalling the ancient Greek astronomer **Hipparchus**.

What Did It Measure?

Measurement	Simple explanation
Position	Where a star appears in the sky.
Parallax	Its apparent positional shift as Earth travels around the Sun, used to calculate distance.
Proper motion	Its gradual movement across the sky relative to more distant objects.
Photometry	Its measured brightness and changes in brightness.

- **Parallax example:** Hold a finger in front of your face and alternately close each eye. Your finger appears to shift against the background. Astronomers use a similar geometric principle with observations from different positions in Earth's orbit.
- The principal **Hipparcos Catalogue contains 118,218 stars**. The associated Tycho observations produced a much larger, less precise catalogue.
- Its successor, **Gaia**, greatly expanded the scale and precision of stellar mapping.

Photometry Data

- **Photometry means measuring the amount of light received from an object.** In astronomy, photometric data record a star's or galaxy's **brightness**, often in selected wavelength bands or colours.
- Repeated measurements show whether brightness changes over time. A graph of brightness against time is called a **light curve**.

What Can It Tell Us?

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- **Colour and temperature:** After accounting for effects such as dust, a star's colour helps estimate its surface temperature. Bluer stars are generally hotter than redder stars.
- **Variability:** Repeated brightness changes can reveal pulsating stars or stars eclipsing one another.
- **Planet detection:** A small, repeated dip may indicate a planet passing in front of its star.
- **Stellar properties:** Combined with distance measurements and models, photometry helps estimate luminosity and other physical characteristics.
- **Important distinction:** A star that looks faint may be intrinsically dim, very distant or obscured by dust. **Apparent brightness alone does not establish its true luminosity.**

Spectroscopy

- **Spectroscopy separates light into its component wavelengths and analyses the resulting spectrum.**
- A prism spreading sunlight into a rainbow provides a simple analogy. Astronomical instruments reveal much finer details, including **absorption and emission lines**.

How Does It Work?

- Different atoms and molecules absorb or emit light at characteristic wavelengths.
- Their spectral lines act like **identifying fingerprints**, allowing astronomers to investigate distant objects without collecting physical samples.

Main Uses

- **Composition:** Spectral lines reveal elements such as hydrogen, helium, calcium and iron.
- **Temperature and physical conditions:** The pattern and strength of lines help determine stellar properties.
- **Motion:** Shifts in spectral lines reveal movement **towards or away from us**, called **radial velocity**.
- **Galactic history:** Chemical composition and motion help distinguish different stellar populations.
- **Example:** Stars moving together and showing similar chemical patterns may have originated in the same smaller galaxy or star cluster. This inference becomes stronger when several measurements agree.

Milky Way

- The **Milky Way is the galaxy containing our Solar System**.
- A galaxy is a gravitationally bound system containing stars, gas, dust and **dark matter**.
- The Milky Way is a **barred spiral galaxy**: it has a central elongated bar and a disc containing spiral arms.
- Its main stellar disc is approximately **100,000 light-years across**. A **light-year is a unit of distance**, meaning the distance light travels in one year.

- The faint luminous band seen across a dark night sky is our view through the galaxy's crowded disc.

Component	Description
Disc and spiral arms	Contain stars, gas, dust and many star-forming regions.
Central bar and bulge	Dense central stellar structures.
Stellar halo	A more extended population containing old stars, globular clusters and stellar streams.
Dark-matter halo	An extensive, unseen component inferred from gravitational effects.

How the Concepts Connect

- **Astrometry** measures where stars are and how they move across the sky. **Photometry** measures their brightness and colour. **Spectroscopy** reveals their chemical properties and line-of-sight motion.
- Together, these methods help identify **stars stripped from galaxies such as Sagittarius**, allowing astronomers to reconstruct how the **Milky Way formed and evolved**. This approach is often called **galactic archaeology**.

PATRIOTIC IAS

New technique uses light to spot deepfakes in seconds

GS III: S&T

Vasudevan Mukunth

Many deepfake videos are easy to spot – the eyes move in strange ways, there's an extra finger on a hand or the light is weirdly distributed – but many are just as hard, if not impossible. Recent research in *Nature Communications* found that humans are able to spot deepfakes only 50% of the time.

In a leg-up to humans in this fight against unreal information, researchers at the University of California, Los Angeles, have found a way to tell if a video is a deepfake based on the light in it. In lab tests, the method was so good that it almost never failed to spot a manipulated video.

Based on the findings, published in the journal *eLight*, the researchers have said it could reduce the burden on social media platforms, which currently process large quantities of user-submitted videos using resource-intensive techniques.

Deepfake videos have emerged as a scourge to society by playing on people's interest in videos and the general belief that videos are hard to fake. However, artificial intelligence (AI) has short-circuited the latter by allowing users to quickly and easily modify videos, often at low cost.

Thus, deepfakes have emerged during elections purporting to show politicians saying things they did not and to show men and women committing obscene acts that, in reality, they never did.

While AI-based detectors can identify videos with such falsified information, they require large amounts of computing power. The bad actors who produce these videos also sidestep such tools by compressing the video or deliberately blurring it. The technique reported in the new work combines an electronic computer – one that works with chips – with an optical computer, i.e. a machine where light performs part of the work normally done by chips.

A program running on this machine selects 12 frames from the video in question and checks the faces in them for patterns that could set them apart. Then the program feeds what information it has gathered into a device called a spatial light modulator and then to two spots on a sensor. Based on the difference in brightness between these spots, the system could say whether a video was fake.

In tests, the system was able to identify manipulated videos with an accuracy of 99.86% and real videos with an accuracy of 95.72% – while processing 15 videos at a time. Even when the number of videos being processed together was pushed to 18, the overall accuracy only fell to 96.13%. The system also identified videos made with the Google Veo 3 AI model with an accuracy of 94.8%, signalling that it doesn't have to be trained from scratch against content generated by the latest AI models.

The researchers estimated that the optical part of the machine consumed sevenfold less energy than the electronic part. That said, since the machine requires both parts to work, its overall energy consumption was a more modest 13% lower than a fully electronic setup.

Based on these findings, the researchers have proposed that social media platforms et al. can use the system as a filter that flags videos that do need to be checked further, liberating the platforms from having to check all of them.

03N11. New technique uses light to spot deepfakes in seconds

नई तकनीक प्रकाश से कुछ ही सेकंड में डीपफेक की पहचान करती है।

- Many **deepfake videos** are easy to spot — the eyes move in strange ways, there's an extra finger on a hand or the light is weirdly distributed — but many are just as hard, if not impossible.

कई **डीपफेक वीडियो** की पहचान करना आसान होता है—आँखें असामान्य तरीके से घूमती हैं, हाथ में एक अतिरिक्त उँगली दिखाई देती है या प्रकाश असामान्य रूप से वितरित होता है—लेकिन कई अन्य वीडियो की पहचान करना उतना ही कठिन, बल्कि लगभग असंभव होता है।

- Recent research in *Nature Communications* found that humans are able to spot deepfakes only 50% of the time.

नेचर कम्युनिकेशंस में प्रकाशित हालिया शोध में पाया गया कि मनुष्य केवल 50% मामलों में ही डीपफेक की पहचान कर पाते हैं।

- In a leg-up to humans in this fight against unreal information, researchers at the University of California, Los Angeles, have found a way to tell if a video is a deepfake based on the **light** in it.
  भ्रामक सूचनाओं के विरुद्ध इस संघर्ष में मनुष्यों को बढ़त दिलाने के लिए, कैलिफोर्निया विश्वविद्यालय, लॉस एंजिल्स के शोधकर्ताओं ने वीडियो में मौजूद **प्रकाश** के आधार पर यह पता लगाने का तरीका खोजा है कि कोई वीडियो डीपफेक है या नहीं।
- In lab tests, the method was so good that it almost never failed to spot a manipulated video.
  प्रयोगशाला परीक्षणों में यह विधि इतनी प्रभावी रही कि हेरफेर किए गए वीडियो की पहचान करने में यह लगभग कभी विफल नहीं हुई।
- Based on the findings, published in the journal *eLight*, the researchers have said it could reduce the burden on social media platforms, which currently process large quantities of user-submitted videos using resource-intensive techniques.
  eLight शोध पत्रिका में प्रकाशित निष्कर्षों के आधार पर शोधकर्ताओं ने कहा है कि यह तकनीक सोशल मीडिया प्लेटफॉर्मों पर पड़ने वाला बोझ कम कर सकती है। ये प्लेटफॉर्म फिलहाल उपयोगकर्ताओं द्वारा अपलोड किए गए बड़ी मात्रा के वीडियो का विश्लेषण करने के लिए अधिक संसाधन खपाने वाली तकनीकों का इस्तेमाल करते हैं।
- **Deepfake videos** have emerged as a scourge to society by playing on people's interest in videos and the general belief that videos are hard to fake.
  लोगों की वीडियो में रुचि और इस आम धारणा का लाभ उठाकर कि वीडियो में हेरफेर करना कठिन है, **डीपफेक वीडियो** समाज के लिए एक गंभीर समस्या बनकर उभरे हैं।
- However, **artificial intelligence (AI)** has short-circuited the latter by allowing users to quickly and easily modify videos, often at low cost.
  हालाँकि, **कृत्रिम बुद्धिमत्ता (AI)** ने इस धारणा को अप्रासंगिक कर दिया है, क्योंकि यह उपयोगकर्ताओं को अक्सर कम लागत पर वीडियो में तेज़ी और आसानी से बदलाव करने की सुविधा देती है।
- Thus, deepfakes have emerged during elections purporting to show politicians saying things they did not and to show men and women committing obscene acts that, in reality, they never did.
  इस तरह, चुनावों के दौरान ऐसे डीपफेक सामने आए हैं जिनमें राजनेताओं को ऐसी बातें कहते हुए दिखाया जाता है जो उन्होंने कभी नहीं कहीं, और पुरुषों तथा महिलाओं को ऐसे अश्लील कृत्य करते हुए दिखाया जाता है जिन्हें उन्होंने वास्तव में कभी नहीं किया।
- While **AI-based detectors** can identify videos with such falsified information, they require large amounts of **computing power**.
  हालाँकि **AI-आधारित पहचान प्रणालियाँ** ऐसी झूठी जानकारी वाले वीडियो की पहचान कर सकती हैं, लेकिन इनके लिए बहुत अधिक **कंप्यूटिंग क्षमता** की आवश्यकता होती है।
- The bad actors who produce these videos also sidestep such tools by compressing the video or deliberately blurring it.
  ऐसे वीडियो बनाने वाले दुर्भावनापूर्ण लोग वीडियो को संपीड़ित करके या जानबूझकर धुँधला करके इन उपकरणों को भी चकमा दे देते हैं।
- The technique reported in the new work combines an **electronic computer** — one that works with chips — with an **optical computer**, i.e. a machine where light performs part of the work normally done by chips.
  नए शोध में बताई गई तकनीक एक **इलेक्ट्रॉनिक कंप्यूटर**—जो चिपों के माध्यम से काम करता है—को एक **प्रकाशीय कंप्यूटर** से जोड़ती है। प्रकाशीय कंप्यूटर ऐसी मशीन है जिसमें सामान्यतः चिपों द्वारा किए जाने वाले काम का एक हिस्सा प्रकाश करता है।
- A program running on this machine selects 12 frames from the video in question and checks the faces in them for patterns that could set them apart.
  इस मशीन पर चलने वाला एक प्रोग्राम संबंधित वीडियो से 12 फ्रेम चुनता है और उनमें मौजूद चेहरों में ऐसे पैटर्न जाँचता है जो उन्हें अलग पहचानने में मदद कर सकते हैं।

- Then the program feeds what information it has gathered into a device called a **spatial light modulator** and then to two spots on a sensor.
  इसके बाद प्रोग्राम एकत्र की गई जानकारी को **स्थानिक प्रकाश मॉड्यूलेटर** नामक उपकरण में भेजता है और फिर सेंसर के दो बिंदुओं तक पहुँचाता है।
- Based on the difference in brightness between these spots, the system could say whether a video was fake.
  इन दोनों बिंदुओं की चमक के अंतर के आधार पर प्रणाली बता सकती है कि कोई वीडियो नकली है या नहीं।
- In tests, the system was able to identify manipulated videos with an accuracy of 99.86% and real videos with an accuracy of 95.72% — while processing 15 videos at a time.
  परीक्षणों में, एक बार में 15 वीडियो संसाधित करते हुए, यह प्रणाली हेरफेर किए गए वीडियो की पहचान 99.86% और वास्तविक वीडियो की पहचान 95.72% सटीकता से कर सकी।
- Even when the number of videos being processed together was pushed to 18, the overall accuracy only fell to 96.13%.
  एक साथ संसाधित किए जा रहे वीडियो की संख्या बढ़ाकर 18 करने पर भी, प्रणाली की कुल सटीकता घटकर केवल 96.13% हुई।
- The system also identified videos made with the **Google Veo 3 AI model** with an accuracy of 94.8%, signalling that it doesn't have to be trained from scratch against content generated by the latest AI models.
  प्रणाली ने **Google Veo 3 AI मॉडल** से बनाए गए वीडियो की पहचान भी 94.8% सटीकता से की। इससे संकेत मिलता है कि नवीनतम AI मॉडलों द्वारा बनाई गई सामग्री की पहचान करने के लिए इसे शुरू से प्रशिक्षित करने की आवश्यकता नहीं है।
- The researchers estimated that the **optical part** of the machine consumed sevenfold less energy than the electronic part.
  शोधकर्ताओं ने अनुमान लगाया कि मशीन के **प्रकाशीय भाग** ने इलेक्ट्रॉनिक भाग की तुलना में सात गुना कम ऊर्जा खर्च की।
- That said, since the machine requires both parts to work, its overall energy consumption was a more modest 13% lower than a fully electronic setup.
  हालाँकि, चूँकि मशीन को काम करने के लिए दोनों भागों की आवश्यकता होती है, इसलिए इसकी कुल ऊर्जा खपत पूरी तरह इलेक्ट्रॉनिक प्रणाली की तुलना में केवल 13% कम थी।
- Based on these findings, the researchers have proposed that social media platforms et al. can use the system as a **filter** that flags videos that do need to be checked further, liberating the platforms from having to check all of them.
  इन निष्कर्षों के आधार पर शोधकर्ताओं ने प्रस्ताव दिया है कि सोशल मीडिया प्लेटफॉर्म और अन्य संबंधित संस्थाएँ इस प्रणाली को **फ़िल्टर** के रूप में इस्तेमाल कर सकती हैं। यह उन वीडियो को चिह्नित करेगा जिनकी आगे जाँच की ज़रूरत है, जिससे प्लेटफॉर्मों को हर वीडियो की जाँच नहीं करनी पड़ेगी।

A **deepfake** is AI-generated or AI-manipulated media that can make someone appear to say or do something they never did. Looking for unusual fingers or facial movements can help, but convincing deepfakes may contain no obvious visual mistakes.

The problem with conventional detection

> "An ordinary AI detector examines patterns in videos using electronic computer chips. Processing huge numbers of videos requires computing resources and electricity. Researchers are exploring whether light can perform part of this work efficiently."

The new system is therefore a **hybrid electronic–optical detector**, combining a digital front end with an optical processing stage.

The process in five simple steps

Stage	What students should understand
Select frames	The computer samples **12 frames**—individual still pictures—from a video.
Extract patterns	A trained program converts information about the faces and their changes across frames into a numerical representation.
Encode information onto light	A **spatial light modulator** places the resulting pattern onto a beam of light.
Perform optical processing	As light travels through the specially designed optical system, its waves spread and combine, performing part of the trained computation.
Read the output	A sensor compares light intensity at **two designated regions**, producing a score used to classify the video as genuine or fake.

- **Spatial light modulator analogy:** Describe it as a **programmable screen that controls a light wave differently at different points**.
- It can change the wave's timing, or **phase**, rather than simply making the whole beam brighter or dimmer.
- **Important:** Light does not independently "understand truth." The system has been **trained and engineered** to convert particular input patterns into distinguishable outputs.

An airport-security analogy

> "Think of the system as an airport screening machine. It quickly flags suspicious baggage for closer examination. Similarly, this detector could flag suspicious videos for further checking."

This explains its proposed role as a **first-stage filter**, rather than a final authority on whether every video is authentic.

For the experiment processing **15 videos in parallel**, distinguish three measures:

Reported result	Plain-language meaning
99.86% sensitivity	It correctly flagged approximately **999 out of every 1,000 fake videos** under those test conditions.
95.72% specificity	It correctly recognised approximately **957 out of every 1,000 genuine videos**; around **43 could be wrongly flagged**.
97.79% average detection accuracy	This was the reported average accuracy for that experimental configuration.

The energy claim

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Explain the article's figures this way:

> "One component may save a lot of electricity, but the entire machine still includes other components that consume power."

Thus, the reported **roughly sevenfold reduction for the optical stage** does **not** mean the complete machine uses seven times less energy. The article reports an overall saving of approximately **13%**.

- **Laboratory success is not universal reliability.** Different faces, video sources and new manipulation methods can affect performance.
- **Detecting some Veo 3 videos does not prove detection of every future AI model.**
- A genuine video can still mislead through a **false caption, selective editing or missing context**.
- The reported **50% human performance** concerns a particular study, not a fixed limit on everyone's abilities.

Closing line:

> **"The innovation is using light as a computing tool to help screen deepfakes efficiently. Its output is a warning signal to investigate—not an unquestionable verdict."**

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How smoking sets the stage for lung cancer, glimpsed in new study

Chronic smoke exposure alters lung stem cells and weakens their safety mechanisms and local immune defences, creating a precancerous state; common KRAS and TP53 mutations triggered tumours only in smoke-conditioned tissue, showing how smoking primes cells for cancer

GS III: S&T

Anirban Mukhopadhyay

Na Wang, Raksha Padaki, Sara-Jayne Thursby and Michelle Vaz, 'Chronic Cigarette Smoke Exposure Induces Distinct Stem Cell States Driving Genetic Driver-specific Non-small Cell Lung Cancer Subtypes', Proceedings of the National Academy of Sciences, Vol. 123, Issue No. 42, October 5, 2026



GETTY IMAGES

Oncologists have long wrestled with a conundrum. Healthy human tissue often carries mutations that can drive cancer, but the tissue itself does not develop tumours. Clearly, a genetic spark alone is not enough. At the same time, chronic inflammation from smoking profoundly damages lung tissue long before any definitive cancer-causing mutations even take root.

How then does smoking increase the risk of lung cancer?

Results published in the *Proceedings of the National Academy of Sciences* on October 5 have reported a crucial missing link.

'Change the soil'

Using lab-grown lung organoids, researchers showed that chronic exposure to cigarette smoke can prime certain lung stem cells into a 'precancerous' state by turning off their safety switches and dulling local immune defences.

This long-term inflammatory stress does not instantly form a tumour in the body. Instead, it prepares cells so that when common genetic mutations eventually occur, they can trigger the onset of a cancer.

If we think of normal lung cells as "healthy seeds", the research shows how long-term smoke exposure gradually changes the "soil around them", Sendurai Mani, a professor of translational oncology at Brown University and who was not involved in the study, said.

The findings have a significant implication for India. In a May 2020 analysis of 1,862 patients, a team at AIIMS New Delhi identified adenocarcinoma and squamous cell carcinoma as the country's most common lung cancers – the exact two subtypes formed by smoke-primed cells in the new study.

Understanding how persistent, low-grade inflammatory stress sets the stage for cancer is also critical because a substantial proportion of India's lung cancer cases occur among non-smokers exposed to severe air pollution and biomass smoke from traditional cooking stoves.

Tissue decline

To track how normal lung tissue deteriorates, the researchers, at the Johns Hopkins University School of Medicine and the Van Andel Research Institute in the U.S., turned to lung organoids – microscopic, three-dimensional 'mini-lungs' grown in the laboratory from mouse and human lung tissue.

The team treated these organoids with a liquid extract containing the chemical components and toxins of cigarette smoke for up to six months. Then they compared them to a group of unexposed organoids.

Within one to three months, certain cells in the smoke-exposed organoids grew significantly faster and formed denser, more crowded clusters than the controls. This growth came at a cost to normal cellular function. Stem cells destined to mature into either the airway lining or fragile alveolar air sacs expanded rapidly and adopted an altered, injury-like identity.

Simultaneously, the numbers of specialised cells that usually keep airways clean steadily declined. The lab-grown tissue became trapped in a disordered, unhealed state known as metaplasia, akin to how skin forms a thick callus in response to repeated friction.

Reprogramming cells

During the six months, the cells did not spontaneously acquire the traditional mutations that drive cancer. Instead, the smoke inflicted its damage through epigenetic changes – a bit like reprogramming a computer, explained Michelle Vaz, an oncologist at Johns Hopkins and a study co-author. The cell's underlying DNA hardware remains largely intact but the software instructions dictating how it should behave change.

By scanning how the cells packaged their DNA, the team discovered that chronic smoke caused the regulatory regions of genes crucial to a cell's survival to shut down. Chief among these silenced genes was *Zbp1*, a master sensor that detects cellular stress and initiates a process that forces damaged cells to self-destruct. As these instructions change, the cells "lose some of their normal controls," Dr. Vaz said.

The smoke-conditioned tissue also affected its environment. When grown alongside macrophages, the immune system's patrol cells, the altered lung cells coaxed them to switch sides, turning the cancer-fighters into accomplices that help abnormal cells hide.

Genetic spark

To test if these changes could really prepare the cells for malignancy, the researchers introduced two of the most common genetic alterations seen in human non-small cell lung cancer. They engineered different batches of the six-month organoids to carry either a cancer-driving mutation in the *Kras* gene or the loss of the *Tp53* tumour suppressor gene. Then they implanted these organoids into mice to see if they would grow into actual tumours.

Smoke exposure alone was not enough to trigger cancer in the animals. Introducing either mutation into healthy, unexposed organoids also failed to produce tumours. Instead, the tumours formed exclusively when the mutations were introduced to organoids that had already been conditioned to chronic smoke.

The two mutations also set off changes along different pathways: the *Kras* mutation acted on stem cells deeper in the lungs, giving rise to lung adenocarcinoma, while the loss of *Tp53* targeted stem cells in the airway lining and produced squamous cell carcinoma.

Biological memory

Instead of viewing cancer as an inevitable consequence of random DNA mutations, the findings suggest chronic smoke is essentially "preparing the ground for cancer", as Dr. Vaz noted, making distinct pools of stem cells uniquely vulnerable to certain genetic mutations.

Translating these lab-grown insights into actual human treatments or screening tools will not be easy. Human lung cancer is a very complex, decades-long process, Nithya Ramnath, professor of medicine at the University of Michigan, said. She pointed out that artificially engineering mutations in a lab dish bypasses the messy reality of how human bodies naturally acquire mutations, repair tissues, and conduct immune surveillance over a lifetime.

And while the study offers clues into one conundrum, Prof. Ramnath cautioned that a "critical unanswered question remains": why only a minority of individuals exposed to decades of heavy smoking ultimately develop lung cancer while some who have never smoked do.

Until researchers can unravel that mystery in real human populations, she said, the findings should be regarded as "hypothesis generating rather than actionable".

(Anirban Mukhopadhyay is a geneticist by training and science communicator from New Delhi)

03N11. How smoking sets the stage for lung cancer, glimpsed in new study
नए अध्ययन से मिली झलक: धूम्रपान कैसे फेफड़ों के कैंसर की ज़मीन तैयार करता है

- Oncologists have long wrestled with a conundrum.
  कैंसर विशेषज्ञ लंबे समय से एक उलझन से जूझते रहे हैं।
- Healthy human tissue often carries mutations that can drive cancer, but the tissue itself does not develop tumours.
  स्वस्थ मानव ऊतकों में अक्सर ऐसे उत्परिवर्तन होते हैं जो कैंसर को बढ़ावा दे सकते हैं, लेकिन ऊतक स्वयं ट्यूमर विकसित नहीं करता।

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- Clearly, a genetic spark alone is not enough.
  स्पष्ट है कि केवल आनुवंशिक बदलाव ही पर्याप्त नहीं है।
- At the same time, chronic inflammation from smoking profoundly damages lung tissue long before any definitive cancer-causing mutations even take root.
  साथ ही, धूम्रपान से होने वाली दीर्घकालिक **सूजन** फेफड़ों के ऊतकों को उस समय से बहुत पहले गंभीर नुकसान पहुँचाती है, जब तक कैंसर पैदा करने वाले निश्चित आनुवंशिक उत्परिवर्तन विकसित भी नहीं होते।
- How then does smoking increase the risk of lung cancer?
  तो फिर धूम्रपान फेफड़ों के कैंसर का जोखिम कैसे बढ़ाता है?
- Results published in *Proceedings of the National Academy of Sciences* on October 5 have reported a crucial missing link.
  5 अक्टूबर को *प्रोसीडिंग्स ऑफ द नेशनल एकेडमी ऑफ साइंसेज़* में प्रकाशित नतीजों ने इस पहेली की एक महत्त्वपूर्ण कड़ी सामने रखी है।

'Change the soil'
'ज़मीन को बदलना'

- Using lab-grown **lung organoids**, researchers showed that chronic exposure to cigarette smoke can prime certain lung stem cells into a 'precancerous' state by turning off their safety switches and dulling local immune defences.
  प्रयोगशाला में विकसित **फेफड़े के ऑर्गेनॉइड** का उपयोग करके शोधकर्ताओं ने दिखाया कि सिगरेट के धुएँ के लंबे समय तक संपर्क में रहने से फेफड़ों की कुछ स्टेम कोशिकाएँ 'कैंसर-पूर्व' अवस्था में पहुँच सकती हैं। ऐसा उनकी सुरक्षा-व्यवस्थाओं को बंद करके और स्थानीय प्रतिरक्षा सुरक्षा को कमज़ोर करके होता है।
- This long-term inflammatory stress does not instantly form a tumour in the body.
  यह दीर्घकालिक सूजनजन्य तनाव शरीर में तुरंत ट्यूमर नहीं बनाता।
- Instead, it prepares cells so that when common genetic mutations eventually occur, they can trigger the onset of a cancer.
  इसके बजाय, यह कोशिकाओं को इस तरह तैयार करता है कि आम आनुवंशिक उत्परिवर्तन होने पर वे कैंसर की शुरुआत कर सकें।
- If we think of normal lung cells as "healthy seeds", the research shows how long-term smoke exposure gradually changes the "soil around them", Sendurai Mani, a professor of translational oncology at Brown University and who was not involved in the study, said.
  ब्राउन विश्वविद्यालय में ट्रांसलेशनल ऑन्कोलॉजी के प्रोफेसर और अध्ययन में शामिल न रहे सेंधुरै मणि ने कहा, "यदि हम सामान्य फेफड़ा कोशिकाओं को 'स्वस्थ बीज' मानें, तो यह शोध दिखाता है कि लंबे समय तक धुएँ के संपर्क में रहने से धीरे-धीरे 'उनके आसपास की ज़मीन' कैसे बदल जाती है।"
- The findings have a significant implication for India.
  इन निष्कर्षों का भारत के लिए महत्त्वपूर्ण निहितार्थ है।
- In a May 2020 analysis of 1,862 patients, a team at AIIMS New Delhi identified **adenocarcinoma** and **squamous cell carcinoma** as the country's most common lung cancers — the exact two subtypes formed by smoke-primed cells in the new study.
  मई 2020 में 1,862 रोगियों के विश्लेषण में, एम्स नई दिल्ली की एक टीम ने **एडेनोकार्सिनोमा** और **स्क्वैमस सेल कार्सिनोमा** को देश में फेफड़ों का सबसे आम कैंसर पाया था। नए अध्ययन में धुएँ से प्रभावित कोशिकाओं से ठीक यही दो उपप्रकार बनते दिखे।
- Understanding how persistent, low-grade inflammatory stress sets the stage for cancer is also critical because a substantial proportion of India's lung cancer cases occur among non-smokers exposed to severe air pollution and biomass smoke from traditional cooking stoves.
  यह समझना भी अत्यंत महत्त्वपूर्ण है कि लगातार बना रहने वाला, कम स्तर का सूजनजन्य तनाव कैंसर की ज़मीन कैसे तैयार करता है, क्योंकि भारत में फेफड़ों के कैंसर के काफ़ी मामले उन लोगों में होते हैं जो धूम्रपान

नहीं करते, लेकिन गंभीर वायु प्रदूषण और पारंपरिक चूल्हों से निकलने वाले बायोमास के धुएँ के संपर्क में रहते हैं।

Tissue decline
ऊतकों का क्षरण

- To track how normal lung tissue deteriorates, the researchers, at the Johns Hopkins University School of Medicine and the Van Andel Research Institute in the U.S., turned to lung organoids — microscopic, three-dimensional 'mini-lungs' grown in the laboratory from mouse and human lung tissue.
  सामान्य फेफड़े के ऊतक कैसे ख़राब होते हैं, इसका पता लगाने के लिए अमेरिका के जॉन्स हॉपकिन्स यूनिवर्सिटी स्कूल ऑफ मेडिसिन और वैन एंडेल रिसर्च इंस्टीट्यूट के शोधकर्ताओं ने फेफड़े के ऑर्गेनॉइड का सहारा लिया। ये चूहे और मानव फेफड़े के ऊतकों से प्रयोगशाला में विकसित सूक्ष्म, त्रि-आयामी 'मिनी-लंग्स' होते हैं।
- The team treated these organoids with a liquid extract containing the chemical components and toxins of cigarette smoke for up to six months.
  शोधकर्ताओं ने इन ऑर्गेनॉइड को सिगरेट के धुएँ के रासायनिक घटकों और विषैले पदार्थों वाले तरल अर्क के संपर्क में छह महीने तक रखा।
- Then they compared them to a group of unexposed organoids.
  इसके बाद उन्होंने उनकी तुलना ऐसे ऑर्गेनॉइड के एक समूह से की जिन्हें धुएँ के संपर्क में नहीं रखा गया था।
- Within one to three months, certain cells in the smoke-exposed organoids grew significantly faster and formed denser, more crowded clusters than the controls.
  एक से तीन महीनों के भीतर, धुएँ के संपर्क में रहे ऑर्गेनॉइड की कुछ कोशिकाएँ नियंत्रण समूह की कोशिकाओं की तुलना में काफ़ी तेज़ी से बढ़ीं और अधिक घने तथा भीड़भरे समूह बनाने लगीं।
- This growth came at a cost to normal cellular function.
  इस बढ़ोतरी की कीमत कोशिकाओं के सामान्य कामकाज को चुकानी पड़ी।
- Stem cells destined to mature into either the airway lining or fragile alveolar air sacs expanded rapidly and adopted an altered, injury-like identity.
  वायुमार्ग की परत या नाज़ुक वायुकोषों में विकसित होने वाली स्टेम कोशिकाएँ तेज़ी से बढ़ीं और उन्होंने बदली हुई, चोटग्रस्त कोशिकाओं जैसी पहचान अपना ली।
- Simultaneously, the numbers of specialised cells that usually keep airways clean steadily declined.
  इसी दौरान, वायुमार्ग को साफ़ रखने वाली विशिष्ट कोशिकाओं की संख्या लगातार घटती गई।
- The lab-grown tissue became trapped in a disordered, unhealed state known as **metaplasia**, akin to how skin forms a thick callus in response to repeated friction.
  प्रयोगशाला में विकसित ऊतक **मेटाप्लासिया** नामक अव्यवस्थित और ठीक न होने वाली अवस्था में फँस गया। यह उस प्रक्रिया जैसा है जिसमें बार-बार घर्षण होने पर त्वचा पर मोटा घट्टा बन जाता है।

Reprogramming cells
कोशिकाओं का पुनःप्रोग्रामन

- During the six months, the cells did not spontaneously acquire the traditional mutations that drive cancer.
  छह महीनों के दौरान कोशिकाओं में अपने-आप कैंसर को बढ़ावा देने वाले पारंपरिक उत्परिवर्तन पैदा नहीं हुए।
- Instead, the smoke inflicted its damage through **epigenetic changes** — a bit like reprogramming a computer, explained Michelle Vaz, an oncologist at Johns Hopkins and a study co-author.
  इसके बजाय, जॉन्स हॉपकिन्स की कैंसर विशेषज्ञ और अध्ययन की सह-लेखिका मिशेल वाज़ ने समझाया कि धुएँ ने **एपिजेनेटिक बदलावों** के ज़रिए नुकसान पहुँचाया—कुछ-कुछ कंप्यूटर को फिर से प्रोग्राम करने जैसा।

- The cell's underlying DNA hardware remains largely intact but the software instructions dictating how it should behave change.
  कोशिका का मूल DNA हार्डवेयर काफी हद तक जस का तस रहता है, लेकिन उसके व्यवहार को तय करने वाले सॉफ़्टवेयर निर्देश बदल जाते हैं।
- By scanning how the cells packaged their DNA, the team discovered that chronic smoke caused the regulatory regions of genes crucial to a cell's survival to shut down.
  कोशिकाओं द्वारा अपने DNA को व्यवस्थित करने के तरीकों की जाँच करके शोधकर्ताओं ने पाया कि लंबे समय तक धुएँ के संपर्क में रहने से कोशिका के जीवित रहने के लिए महत्वपूर्ण जीनों के नियामक क्षेत्र बंद हो गए।
- Chief among these silenced genes was **Zbp1**, a master sensor that detects cellular stress and initiates a process that forces damaged cells to self-destruct.
  इन निष्क्रिय हुए जीनों में प्रमुख **Zbp1** था—एक मुख्य संवेदक जो कोशिकीय तनाव का पता लगाता है और ऐसी प्रक्रिया शुरू करता है जो क्षतिग्रस्त कोशिकाओं को स्वयं नष्ट होने के लिए प्रेरित करती है।
- As these instructions change, the cells "lose some of their normal controls," Dr. Vaz said.
  डॉ. वाज़ ने कहा कि इन निर्देशों के बदलने से कोशिकाएँ "अपने कुछ सामान्य नियंत्रण खो देती हैं।"
- The smoke-conditioned tissue also affected its environment.
  धुएँ के प्रभाव से बदले ऊतक ने अपने आसपास के वातावरण को भी प्रभावित किया।
- When grown alongside macrophages, the immune system's patrol cells, the altered lung cells coaxed them to switch sides, turning the cancer-fighters into accomplices that help abnormal cells hide.
  जब बदली हुई फेफड़ा कोशिकाओं को प्रतिरक्षा तंत्र की गश्ती कोशिकाओं—मैक्रोफेज—के साथ विकसित किया गया, तो उन्होंने मैक्रोफेज को अपना पक्ष बदलने के लिए उकसाया। इससे कैंसर से लड़ने वाली कोशिकाएँ ऐसी सहयोगी बन गईं जो असामान्य कोशिकाओं को छिपने में मदद करती हैं।

Genetic spark
आनुवंशिक चिंगारी

- To test if these changes could really prepare the cells for malignancy, the researchers introduced two of the most common genetic alterations seen in human **non-small cell lung cancer**.
  यह जाँचने के लिए कि क्या ये बदलाव वास्तव में कोशिकाओं को कैंसर के लिए तैयार कर सकते हैं, शोधकर्ताओं ने मानव **नॉन-स्मॉल सेल लंग कैंसर** में पाए जाने वाले दो सबसे आम आनुवंशिक बदलाव कोशिकाओं में किए।
- They engineered different batches of the six-month organoids to carry either a cancer-driving mutation in the **Kras** gene or the loss of the **Tp53 tumour suppressor gene**.
  उन्होंने छह महीने तक विकसित ऑर्गेनॉइड के अलग-अलग समूहों में या तो कैंसर को बढ़ावा देने वाला **Kras** जीन उत्परिवर्तन डाला या **Tp53 ट्यूमर-दमनकारी जीन** को निष्क्रिय किया।
- Then they implanted these organoids into mice to see if they would grow into actual tumours.
  इसके बाद उन्होंने यह देखने के लिए इन ऑर्गेनॉइड को चूहों में प्रत्यारोपित किया कि क्या उनसे वास्तविक ट्यूमर विकसित होंगे।
- Smoke exposure alone was not enough to trigger cancer in the animals.
  केवल धुएँ के संपर्क से जानवरों में कैंसर शुरू नहीं हुआ।
- Introducing either mutation into healthy, unexposed organoids also failed to produce tumours.
  धुएँ के संपर्क में न आए स्वस्थ ऑर्गेनॉइड में इनमें से कोई भी उत्परिवर्तन डालने पर भी ट्यूमर नहीं बने।
- Instead, the tumours formed exclusively when the mutations were introduced to organoids that had already been conditioned to chronic smoke.
  इसके बजाय, ट्यूमर केवल तभी बने जब उत्परिवर्तन उन ऑर्गेनॉइड में किए गए जो पहले ही लंबे समय तक धुएँ के संपर्क से प्रभावित हो चुके थे।
- The two mutations also set off changes along different pathways: the **Kras mutation** acted on stem cells deeper in the lungs, giving rise to lung adenocarcinoma, while the loss of **Tp53**

targeted stem cells in the airway lining and produced squamous cell carcinoma.
दोनों उत्परिवर्तनों ने अलग-अलग रास्तों से बदलाव शुरू किए: **Kras उत्परिवर्तन** ने फेफड़ों के भीतर गहराई में मौजूद स्टेम कोशिकाओं को प्रभावित किया और उनसे एडेनोकार्सिनोमा विकसित हुआ, जबकि **Tp53** के निष्क्रिय होने से वायुमार्ग की परत वाली स्टेम कोशिकाएँ प्रभावित हुईं और स्क्वैमस सेल कार्सिनोमा बना।

Biological memory
जैविक स्मृति

- Instead of viewing cancer as an inevitable consequence of random DNA mutations, the findings suggest chronic smoke is essentially "preparing the ground for cancer", as Dr. Vaz noted, making distinct pools of stem cells uniquely vulnerable to certain genetic mutations.
  कैंसर को DNA के आकस्मिक उत्परिवर्तनों का अनिवार्य परिणाम मानने के बजाय, निष्कर्ष बताते हैं कि लंबे समय तक धुएँ के संपर्क में रहना मूलतः "कैंसर के लिए ज़मीन तैयार करता है", जैसा कि डॉ. वाज़ ने कहा। इससे स्टेम कोशिकाओं के अलग-अलग समूह कुछ खास आनुवंशिक उत्परिवर्तनों के प्रति विशेष रूप से संवेदनशील हो जाते हैं।
- Translating these lab-grown insights into actual human treatments or screening tools will not be easy.
  प्रयोगशाला में प्राप्त इन निष्कर्षों को मनुष्यों के लिए वास्तविक उपचार या जाँच उपकरणों में बदलना आसान नहीं होगा।
- Human lung cancer is a very complex, decades-long process, Nithya Ramnath, professor of medicine at the University of Michigan, said.
  मिशिगन विश्वविद्यालय में मेडिसिन की प्रोफेसर नित्या रामनाथ ने कहा कि मनुष्यों में फेफड़ों का कैंसर एक अत्यंत जटिल प्रक्रिया है, जो दशकों तक चल सकती है।
- She pointed out that artificially engineering mutations in a lab dish bypasses the messy reality of how human bodies naturally acquire mutations, repair tissues, and conduct immune surveillance over a lifetime.
  उन्होंने बताया कि प्रयोगशाला की प्लेट में कृत्रिम रूप से उत्परिवर्तन पैदा करना उस जटिल वास्तविकता को दरकिनार करता है जिसमें मानव शरीर जीवन भर स्वाभाविक रूप से उत्परिवर्तन हासिल करता है, ऊतकों की मरम्मत करता है और प्रतिरक्षा निगरानी करता है।
- And while the study offers clues into one conundrum, Prof. Ramnath cautioned that a "critical unanswered question remains": why only a minority of individuals exposed to decades of heavy smoking ultimately develop lung cancer while some who have never smoked do.
  और जहाँ यह अध्ययन एक उलझन के बारे में संकेत देता है, वहीं प्रो. रामनाथ ने आगाह किया कि "एक महत्वपूर्ण सवाल अब भी अनुत्तरित है": दशकों तक भारी धूम्रपान करने वाले लोगों में से केवल कुछ को ही अंततः फेफड़ों का कैंसर क्यों होता है, जबकि कुछ ऐसे लोगों को भी यह कैंसर हो जाता है जिन्होंने कभी धूम्रपान नहीं किया।
- Until researchers can unravel that mystery in real human populations, she said, the findings should be regarded as "hypothesis generating rather than actionable".
  उन्होंने कहा कि जब तक शोधकर्ता वास्तविक मानव आबादी में इस रहस्य को नहीं सुलझा लेते, तब तक इन निष्कर्षों को "कार्रवाई योग्य के बजाय परिकल्पना बनाने वाले" नतीजों के रूप में देखा जाना चाहिए।

"Smoking can damage both a cell's genetic instructions and the safety systems that normally stop damaged cells from becoming cancerous."

The study explores the second part—**how smoke prepares lung cells for cancer**.

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"If a cell develops a harmful mutation, will it necessarily become cancerous?"

Answer is **no**. The body has several protective mechanisms. It can repair damage, stop abnormal cells from multiplying, or eliminate them. Cancer can develop when enough of these protections fail.

"Could prolonged smoking weaken these protections even before an important cancer-driving mutation occurs?"

The Analogy of a Factory

"Imagine that a lung cell is a small factory. It has an instruction manual, workers, safety alarms and inspectors."

Biological concept	Factory analogy	Simple meaning
DNA	Instruction manual.	Contains the cell's genetic information.
Genes	Individual instructions.	Help control the cell's functions.
Mutation	A change in the printed instructions.	Changes the DNA sequence.
Epigenetic change	Covering an instruction or restricting access to a page.	Changes gene activity without changing the DNA sequence.
Immune cells	Inspectors and security staff.	Help identify and respond to abnormal cells.
Cancer	A factory expanding without effective controls.	Cells grow uncontrollably and may invade surrounding tissue.

The important distinction: A mutation changes the **text**; an epigenetic change changes **how the text is used**. This is an analogy, rather than a literal description of molecular processes.

What Normally Happens in the Lungs

- **Airways** carry air into and out of the lungs.
- **Alveoli** are tiny air sacs where oxygen enters the blood and carbon dioxide leaves it.
- **Stem cells** help maintain and repair lung tissue.

"When a building is damaged, repair workers replace damaged parts. Lung stem cells perform a comparable repair function."

The research asks what happens when these repair cells face **repeated chemical injury from cigarette smoke**.

What the Researchers Did

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An **organoid** as a **small, three-dimensional laboratory model containing several cell types found in an organ**.

"It is like a model neighbourhood used to study buildings—not a complete city. Similarly, a lung organoid is not a fully functioning lung."

Researchers exposed mainly **mouse lung organoids** to cigarette-smoke condensate for **up to six months**. They also checked important early findings in human-derived organoids. The study was published online in **PNAS on 5 October 2026**.

Experimental Comparison

Experimental condition	Result after implantation into mice
Unexposed organoids without an introduced genetic alteration.	No tumours developed.
Smoke-exposed organoids without an introduced genetic alteration.	No tumours developed.
Unexposed organoids with either tested genetic alteration.	No tumours developed.
Smoke-exposed organoids with either tested genetic alteration.	Tumours developed.

In this particular experiment, **smoke-induced changes and the introduced genetic alteration worked together**. Do not present this as a universal rule for every human cancer.

What Smoke Changed

The Repair System Became Disordered

The article describes cells multiplying abnormally and losing some specialised functions.

"More cells do not necessarily mean healthier tissue. A repair process can produce a crowded, poorly functioning structure."

- **Metaplasia** means that one mature cell type is replaced by another, often in response to persistent irritation.
- **It is not itself cancer**, although certain forms can accompany increased cancer risk.

Some Safety Instructions Became Less Active

The study identified reduced activity of **ZBP1**, which helps regulate inflammatory cell-death pathways.

"A damaged factory unit should sometimes be shut down. If part of the shutdown system becomes less effective, abnormal units may survive."

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Local Immune Defences Were Altered

The changes involving **macrophages**, immune cells that help clear debris and coordinate responses.

"The surrounding environment can influence whether immune cells challenge abnormal cells or inadvertently support their survival."

The finding concerns **particular cellular signals and experimental conditions**.

KRAS and TP53

Gene	Classroom analogy	Alteration tested
KRAS	A growth accelerator.	A mutation promoted growth signalling.
TP53	A safety controller.	Its loss removed an important protective function.

In smoke-conditioned organoids, these alterations produced different cancer types: **adenocarcinoma** with mutant KRAS and **squamous cell carcinoma** with TP53 loss.

Three Misunderstandings

- **The study does not show that smoking cannot cause mutations.** Tobacco smoke contains chemicals that damage DNA; this research adds another mechanism.
- **Six months in an organoid experiment is not a six-month cancer timetable for people.**
- **The findings do not establish a new treatment or screening test.** Further validation is necessary. Quitting smoking remains beneficial and reduces cancer risk.

Recap

- **A mutation changes…** the DNA sequence.
- **An epigenetic change alters…** how genes are used.
- **The study's main finding is…** prolonged smoke exposure can make lung cells more vulnerable to cancer-driving genetic changes.

"Cancer is not always explained by a damaged instruction alone. Whether that damage becomes dangerous also depends on the condition of the cell and its surroundings."

GS Paper III: Environment	03 November 2026
TOPICS COVERED	
03N11	Firecrackers: Festivity or fallout? पटाखे: उत्सव या दुष्परिणाम?

Firecrackers: Festivity or fallout?

GS III: Environment



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Vaishali R. Venkat

The smoke that wafts through our celebrations carries a hidden cost. How can society preserve the joy of celebration without compromising the right to breathe clean air?

On October 12, the Supreme Court's *suo motu* hearing on air pollution in Delhi-NCR brought firecracker restrictions, religious sentiments, and public health into focus. Citing enforcement difficulties, the Bench cautioned against a blanket ban and emphasised public awareness and voluntary restraint to encourage the use of less-polluting alternatives.

Senior advocate Aparajita Singh, the amicus curiae in the matter, urged the Court to ask the Commission for Air Quality Management (CAQM) to address the medical risks associated with air pollution. The proceedings raise a larger constitutional question: how can environmental protection be reconciled with religious freedom without compromising either public health or lawful cultural practice?

Article 21 of the Constitution provides that no person shall be deprived of their life or personal liberty, except according to the procedure established by law. As interpreted by the Supreme Court, the right to life encompasses the right to healthy life. Articles 48A and 51A(g) reinforce this very principle by placing environmental protection within the framework of the Directive Principles of State Policy and Fundamental Duties, respectively. While Article 48A directs the State to protect and improve the environment and safeguard forests and wildlife, Article 51A(g) makes environmental protection a fundamental duty of every citizen. Further, Article 25 guarantees every person freedom of conscience and the right to profess, practise, and propagate religion, subject to public order, morality, and health, among other constitutional limitations. Thus, religious freedom and the freedom to celebrate cannot be treated as an automatic licence to expose others to unreasonable risks to their health. The challenge is not to pit celebration and clean air in opposing camps, but to ensure that the enjoyment of one's freedom does not diminish another's ability to live in a healthy environment.

Religious freedom and freedom to celebrate cannot be treated as an automatic licence to expose others to unreasonable risks to their health

Environmental protection also demands collective action by governments, institutions, and individuals alike. This understanding of shared environmental responsibility extends beyond national constitutions and finds expression in international environmental principles. For instance, the Stockholm Declaration of 1972 recognised that human well-being is intertwined with environmental quality. The Rio Declaration of 1992 articulated two principles that remain pivotal to environmental policymaking: the precautionary principle, which calls for preventive action by the State against serious environmental risks even when scientific certainty is incomplete, and the polluter-pays principle that suggests that the polluter bears the cost of pollution. Applied to the firecracker debate, these principles bring two core concerns into focus: preventing environmental harm and ensuring that those responsible for pollution bear the cost.

The Universal Declaration of Human Rights (UDHR) and the International Covenant on Civil and Political Rights (ICCPR) recognise religious freedom. Moreover, across the globe, countries adopt different approaches to firecracker regulation to protect public safety. For instance, Singapore has banned private firecracker use, permitting only licensed professional fireworks displays. Ireland and the United Kingdom prohibit the sale of traditional firecrackers to the general public. Sweden prohibits the use of firecrackers except by trained individuals holding special permits. Under Germany's explosives regulations, certain powerful firecrackers are restricted to authorised permit holders.

India need not choose between two extremes: a blanket ban and unrestricted use. Regulation can be designed to prevent harm while respecting lawful celebration. This requires scientifically assessing alternatives such as certified green crackers, enforcing emission and safety standards, and holding manufacturers and sellers accountable for violations. The State must ensure that restrictions are proportionate and effectively implemented, while citizens exercise their freedoms with due regard for public health.

After all, a celebration should leave behind memories of joy, not a legacy of polluted air.

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03N11. Firecrackers: Festivity or fallout?
पटाखे: उत्सव या दुष्परिणाम?

- The smoke that wafts through our celebrations carries a hidden cost.
  हमारे उत्सवों में फैलने वाले धुएँ की एक छिपी हुई कीमत है।

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- How can society preserve the joy of celebration without compromising the right to breathe clean air?
  स्वच्छ हवा में साँस लेने के अधिकार से समझौता किए बिना समाज उत्सवों का आनंद कैसे बनाए रख सकता है?
- On October 12, the Supreme Court's suo motu hearing on air pollution in Delhi-NCR brought **firecracker restrictions**, religious sentiments, and public health into focus.
  12 अक्टूबर को दिल्ली-एनसीआर में वायु प्रदूषण पर सर्वोच्च न्यायालय की स्वतः संज्ञान सुनवाई में **पटाखों पर प्रतिबंध**, धार्मिक भावनाओं और जनस्वास्थ्य के मुद्दे प्रमुखता से उठे।
- Citing enforcement difficulties, the Bench cautioned against a blanket ban and emphasised public awareness and voluntary restraint to encourage the use of less-polluting alternatives.
  प्रतिबंध लागू करने में कठिनाइयों का हवाला देते हुए पीठ ने पूर्ण प्रतिबंध लगाने के प्रति आगाह किया और कम प्रदूषण वाले विकल्पों के इस्तेमाल को प्रोत्साहित करने के लिए जन-जागरूकता तथा स्वैच्छिक संयम पर ज़ोर दिया।
- Senior advocate Aparajita Singh, the amicus curiae in the matter, urged the Court to ask the **Commission for Air Quality Management (CAQM)** to address the medical risks associated with air pollution.
  इस मामले में न्यायमित्र वरिष्ठ अधिवक्ता अपराजिता सिंह ने न्यायालय से आग्रह किया कि वह **वायु गुणवत्ता प्रबंधन आयोग (CAQM)** को वायु प्रदूषण से जुड़े चिकित्सकीय जोखिमों पर ध्यान देने को कहे।
- The proceedings raise a larger constitutional question: how can **environmental protection** be reconciled with **religious freedom** without compromising either public health or lawful cultural practice?
  इस सुनवाई से एक व्यापक संवैधानिक प्रश्न उठता है: जनस्वास्थ्य या वैध सांस्कृतिक प्रथाओं से समझौता किए बिना **पर्यावरण संरक्षण** और **धार्मिक स्वतंत्रता** के बीच सामंजस्य कैसे बनाया जा सकता है?
- Article 21 of the Constitution provides that no person shall be deprived of their life or personal liberty, except according to the procedure established by law.
  संविधान का अनुच्छेद 21 कहता है कि किसी भी व्यक्ति को कानून द्वारा स्थापित प्रक्रिया के अनुसार ही उसके जीवन या व्यक्तिगत स्वतंत्रता से वंचित किया जा सकता है।
- As interpreted by the Supreme Court, the **right to life** encompasses the right to a healthy life.
  सर्वोच्च न्यायालय की व्याख्या के अनुसार, **जीवन के अधिकार** में स्वस्थ जीवन का अधिकार भी शामिल है।
- Articles 48A and 51A(g) reinforce this very principle by placing environmental protection within the framework of the Directive Principles of State Policy and Fundamental Duties, respectively.
  अनुच्छेद 48A और 51A(g) क्रमशः राज्य के नीति-निदेशक तत्वों और मूल कर्तव्यों के ढाँचे में पर्यावरण संरक्षण को शामिल करके इसी सिद्धांत को मज़बूत करते हैं।
- While Article 48A directs the State to protect and improve the environment and safeguard forests and wildlife, Article 51A(g) makes environmental protection a fundamental duty of every citizen.
  अनुच्छेद 48A राज्य को पर्यावरण की रक्षा और सुधार करने तथा वनों और वन्यजीवों का संरक्षण करने का निर्देश देता है, जबकि अनुच्छेद 51A(g) पर्यावरण संरक्षण को प्रत्येक नागरिक का मूल कर्तव्य बनाता है।
- Further, Article 25 guarantees every person freedom of conscience and the right to profess, practise, and propagate religion, subject to public order, morality, and health, among other constitutional limitations.
  इसके अलावा, अनुच्छेद 25 प्रत्येक व्यक्ति को अंतःकरण की स्वतंत्रता और धर्म को मानने, उसका पालन करने तथा उसका प्रचार करने का अधिकार देता है, जो सार्वजनिक व्यवस्था, नैतिकता और स्वास्थ्य सहित अन्य संवैधानिक सीमाओं के अधीन है।
- Thus, **religious freedom** and the freedom to celebrate cannot be treated as an automatic licence to expose others to unreasonable risks to their health.
  इसलिए, **धार्मिक स्वतंत्रता** और उत्सव मनाने की आज़ादी को दूसरों के स्वास्थ्य को अनुचित जोखिम में डालने का स्वतः प्राप्त लाइसेंस नहीं माना जा सकता।

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- The challenge is not to pit celebration and clean air in opposing camps, but to ensure that the enjoyment of one's freedom does not diminish another's ability to live in a healthy environment.
  चुनौती उत्सव और स्वच्छ हवा को एक-दूसरे के विरोध में खड़ा करना नहीं, बल्कि यह सुनिश्चित करना है कि किसी व्यक्ति की स्वतंत्रता का आनंद लेने से दूसरे व्यक्ति की स्वस्थ पर्यावरण में जीने की क्षमता कम न हो।
- **Environmental protection** also demands collective action by governments, institutions, and individuals alike.
  पर्यावरण संरक्षण के लिए सरकारों, संस्थाओं और व्यक्तियों—सभी को सामूहिक रूप से कार्रवाई करनी होगी।
- This understanding of shared environmental responsibility extends beyond national constitutions and finds expression in international environmental principles.
  पर्यावरण के प्रति साझा ज़िम्मेदारी की यह समझ राष्ट्रीय संविधानों से आगे जाती है और अंतरराष्ट्रीय पर्यावरणीय सिद्धांतों में भी व्यक्त होती है।
- For instance, the **Stockholm Declaration of 1972** recognised that human well-being is intertwined with environmental quality.
  उदाहरण के लिए, **1972 की स्टॉकहोम घोषणा** ने माना कि मानव कल्याण का पर्यावरण की गुणवत्ता से गहरा संबंध है।
- The **Rio Declaration of 1992** articulated two principles that remain pivotal to environmental policymaking: the **precautionary principle**, which calls for preventive action by the State against serious environmental risks even when scientific certainty is incomplete, and the **polluter-pays principle**, which suggests that the polluter bears the cost of pollution.
  1992 की रियो घोषणा ने दो ऐसे सिद्धांत प्रतिपादित किए जो आज भी पर्यावरण नीति-निर्माण में महत्त्वपूर्ण हैं: **सावधानी का सिद्धांत**, जिसके अनुसार गंभीर पर्यावरणीय जोखिमों के विरुद्ध वैज्ञानिक निश्चितता अधूरी होने पर भी राज्य को निवारक कार्रवाई करनी चाहिए; और **प्रदूषक-भुगतान सिद्धांत**, जिसके अनुसार प्रदूषण की लागत प्रदूषण करने वाले को उठानी चाहिए।
- Applied to the firecracker debate, these principles bring two core concerns into focus: preventing environmental harm and ensuring that those responsible for pollution bear the cost.
  पटाखों पर बहस के संदर्भ में ये सिद्धांत दो बुनियादी चिंताओं को सामने लाते हैं: पर्यावरण को होने वाले नुकसान को रोकना और प्रदूषण के लिए ज़िम्मेदार लोगों से उसकी लागत वसूलना।
- The **Universal Declaration of Human Rights (UDHR)** and the **International Covenant on Civil and Political Rights (ICCPR)** recognise religious freedom.
  मानवाधिकारों की सार्वभौम घोषणा (UDHR) और **नागरिक और राजनीतिक अधिकारों पर अंतरराष्ट्रीय अनुबंध (ICCPR)** धार्मिक स्वतंत्रता को मान्यता देते हैं।
- Moreover, across the globe, countries adopt different approaches to firecracker regulation to protect public safety.
  इसके अलावा, जनसुरक्षा की रक्षा के लिए दुनिया भर के देश पटाखों के विनियमन के अलग-अलग तरीके अपनाते हैं।
- For instance, Singapore has banned private firecracker use, permitting only licensed professional fireworks displays.
  उदाहरण के लिए, सिंगापुर ने निजी तौर पर पटाखों के इस्तेमाल पर प्रतिबंध लगाया है और केवल लाइसेंस प्राप्त पेशेवर आतिशबाज़ी की अनुमति दी है।
- Ireland and the United Kingdom prohibit the sale of traditional firecrackers to the general public.
  आयरलैंड और यूनाइटेड किंगडम आम जनता को पारंपरिक पटाखे बेचने पर रोक लगाते हैं।
- Sweden prohibits the use of firecrackers except by trained individuals holding special permits.
  स्वीडन में विशेष परमिट रखने वाले प्रशिक्षित व्यक्तियों के अलावा किसी और के लिए पटाखों का इस्तेमाल प्रतिबंधित है।
- Under Germany's explosives regulations, certain powerful firecrackers are restricted to authorised permit holders.

जर्मनी के विस्फोटक संबंधी नियमों के तहत, कुछ शक्तिशाली पटाखों का इस्तेमाल केवल अधिकृत परमिटधारक ही कर सकते हैं।

- India need not choose between two extremes: a blanket ban and unrestricted use.
  भारत को दो चरम विकल्पों—पूर्ण प्रतिबंध और बिना रोक-टोक इस्तेमाल—में से किसी एक को चुनने की ज़रूरत नहीं है।
- **Regulation** can be designed to prevent harm while respecting lawful celebration.
  वैध उत्सवों का सम्मान करते हुए नुकसान रोकने के लिए **विनियमन** तैयार किया जा सकता है।
- This requires scientifically assessing alternatives such as certified green crackers, enforcing emission and safety standards, and holding manufacturers and sellers accountable for violations.
  इसके लिए प्रमाणित हरित पटाखों जैसे विकल्पों का वैज्ञानिक आकलन करना, उत्सर्जन और सुरक्षा मानकों को लागू करना तथा उल्लंघन करने वाले निर्माताओं और विक्रेताओं को जवाबदेह ठहराना ज़रूरी है।
- The State must ensure that restrictions are proportionate and effectively implemented, while citizens exercise their freedoms with due regard for public health.
  राज्य को यह सुनिश्चित करना चाहिए कि प्रतिबंध उचित अनुपात में हों और प्रभावी ढंग से लागू किए जाएँ, जबकि नागरिक जनस्वास्थ्य का पूरा ध्यान रखते हुए अपनी स्वतंत्रताओं का इस्तेमाल करें।
- After all, a celebration should leave behind memories of joy,not a legacy of polluted air.
  आखिरकार, उत्सव के बाद खुशी की यादें रहनी चाहिए, न कि एक …

PCS Special:	03 November 2026
03N11	Quiz
03N11	Kimi Antonelli crowned youngest-ever champion किमी एंटोनेली बने अब तक के सबसे युवा चैंपियन

Questions and Answers to the previous day's daily quiz: 1. Why is National Unity Day celebrated every year in India? **Ans: Commemoration of the birth anniversary of Sardar Vallabhbhai Patel**
2. When was Rashtriya Ekta Diwas introduced by the government? **Ans: 2014**
3. What was the core objective of the day? **Ans: To reaffirm the nation's strength, resilience, and commitment to unity**
4. Name one of the key events conducted on National Unity Day? **Ans: Mass public runs organised by States and U.T.s**
5. When was Sardar Vallabhbhai Patel's 150th birth anniversary celebrated? **Ans: 2025**
6. How many years did Sardar Vallabhbhai Patel serve as the Home Minister? **Ans: 1947-50**
7. What is the height of the Statue of Unity (in metres), one of the world's tallest statues, overlooking Sardar Sarovar Dam in Gujarat? **Ans: 182 metres**
Visual: Prime Minister Narendra Modi inaugurated this Statue of Unity in which year? **Ans: 2018**
Early Birds: K.N. Viswanathan | Mohan Lal Patel | Piyali Tuli | Lalchand Bhutani | Sumana Dutta

03N11. Quiz: Sardar Vallabhbhai Patel

1. Why Is National Unity Day Celebrated?

- **National Unity Day**, or **Rashtriya Ekta Diwas**, is observed annually on **31 October** to commemorate the birth anniversary of **Sardar Vallabhbhai Patel**, born in **1875**.
- It honours his contribution to India's political integration, particularly his leadership in bringing princely states into the Indian Union after independence.
- Patel served as independent India's first Deputy Prime Minister and Home Minister, helping consolidate a newly independent country.

2. When Was Rashtriya Ekta Diwas Introduced?

- The Government of India introduced **Rashtriya Ekta Diwas in 2014**, and its first observance took place on **31 October 2014**.
- The date was selected because it marks Sardar Vallabhbhai Patel's birth anniversary. The first celebration therefore coincided with his **139th birth anniversary**.

3. What Is the Core Objective of the Day?

- The central objective is to reaffirm India's **inherent strength and resilience** against actual and potential threats to its **unity, integrity and security**.
- Unity concerns the bonds connecting people across differences, while integrity emphasises the country's continued cohesion and territorial wholeness.

4. What Is One Important Event Organised on the Day?

- The **Run for Unity** is a major public-participation event associated with National Unity Day. States, Union Territories and participating institutions organise runs to express collective commitment to national unity.

5. When Was Patel's 150th Birth Anniversary Celebrated?

- Sardar Vallabhbhai Patel's **150th birth anniversary was celebrated on 31 October 2025**. He was born on **31 October 1875**.

6. How Long Did Patel Serve as Home Minister?

- Sardar Vallabhbhai Patel served as independent India's **first Home Minister from 15 August 1947 until his death on 15 December 1950**.
- He simultaneously held the position of **Deputy Prime Minister** and responsibilities relating to the princely states.

7. What Is the Height of the Statue of Unity?

- The **Statue of Unity stands 182 metres tall** and depicts **Sardar Vallabhbhai Patel**. This measurement refers to the statue itself, rather than its supporting pedestal.
- It is situated at **Ekta Nagar, formerly Kevadia**, in Gujarat's **Narmada district**, overlooking the Sardar Sarovar Dam and its surroundings.
- A viewing gallery is located approximately **153 metres above ground**. It provides views of the dam, reservoir and nearby landscape, helping visitors appreciate both the monument and its geographical setting.

8. In Which Year Was the Statue of Unity Inaugurated?

- Prime Minister **Narendra Modi inaugurated and dedicated the Statue of Unity to the nation on 31 October 2018**.
- The ceremony coincided with **Sardar Vallabhbhai Patel's 143rd birth anniversary**, linking the monument's dedication directly with the leader it commemorates.

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Kimi Antonelli crowned youngest-ever champion

The Mercedes driver, aged 20 years and 68 days, finishes third at the Mexico City GP to become the first Italian champion since Ascari 73 years ago; Verstappen takes the chequered flag

PCS

FORMULA ONE

Reuters
MEXICO CITY

A tearful Kimi Antonelli became Formula One's youngest World champion at 20 years and 68 days old on Sunday when he finished third for Mercedes in a red-flagged and restarted Mexico City Grand Prix won by Red Bull's Max Verstappen.

The first Italian champion since Alberto Ascari in 1953 sobbed with joy over the team radio as he took the chequered flag at the high-altitude Autodromo Hermanos Rodriguez, with his overall lead now an unassailable 119 points.

Ferrari's Lewis Hamilton started from pole position and took a close second place – after clashing with teammate Charles Leclerc – on an afternoon of drama with two safety cars, multiple crashes and an agonising 33-minute halt with 25 of the 71 laps remaining. The previous youngest champion was Germany's Sebastian Vettel, who took the first of his four with Red Bull at 23 years and 134 days in 2010.

Verstappen went second in the overall standings, with Hamilton third and pre-season favourite George Russell plummeting to fourth and 130 points behind Antonelli.

The results: 1. Max Verstappen (Red Bull) 2h: 20m: 28.772s; 2. Lewis Hamilton (Ferrari) + 0.799,



3. Kimi Antonelli (Mercedes) 4.006; 4. Charles Leclerc (Ferrari) 10.707; 5. Lando Norris (McLaren) 11.778; 6. George Russell (Mercedes) 12.263; 7. Oscar Piastri (McLaren) 19.475; 8. Franco Colapinto (Alpine) 20.204; 9. Liam Lawson (Racing Bulls) 20.899; 10. Pierre Gasly (Alpine) 21.483; 11. Gabriel Bortoleto (Audi) 22.041; 12. Isack Hadjar (Red Bull) 22.503; 13. Ryo Hirakawa (Haas) 25.373; 14. Alexander Albon (Williams) 27.562; 15. Carlos Sainz (Williams) 28.638; 16. Nico Hulkenberg (Audi) 29.977; 17. Sergio Perez (Cadillac) 30.695.
DNF: Arvid Lindblad (Racing Bulls); Oliver Bearman (Haas); Valtteri Bottas (Cadillac); Lance Stroll (Aston Martin); Fernando Alonso (Aston Martin).
Standings: Drivers: 1. Antonelli 380 pts.; 2. Verstappen 261; 3. Hamilton 259; 4. Russell 250; 5. Leclerc 245. **Constructors:** 1. Mercedes 630; 2. Ferrari 504; 3. Red Bull 380; 4. McLaren 371; 5. Racing Bulls 104.

03N11. Kimi Antonelli crowned youngest-ever champion
किमी एंटोनेली बने अब तक के सबसे युवा चैंपियन

- A tearful Kimi Antonelli became Formula One's youngest World champion at 20 years and 68 days old on Sunday when he finished third for Mercedes in a red-flagged and restarted Mexico City Grand Prix won by Red Bull's Max Verstappen.

रविवार को आँसुओं से भरे किमी एंटोनेली 20 वर्ष और 68 दिन की उम्र में फ़ॉर्मूला वन के सबसे युवा विश्व चैंपियन बने। उन्होंने रेड बुल के मैक्स वेरस्टैपेन द्वारा जीती गई मेक्सिको सिटी ग्रां प्री में मर्सिडीज़ के लिए तीसरा स्थान हासिल किया। यह रेस लाल झंडा दिखाए जाने के बाद रोक दी गई थी और फिर दोबारा शुरू हुई।

- The first Italian champion since Alberto Ascari in 1953 sobbed with joy over the team radio as he took the chequered flag at the high-altitude Autodromo Hermanos Rodriguez, with his overall lead now an unassailable 119 points.

1953 में अल्बर्टो अस्कारी के बाद पहले इतालवी चैंपियन बने एंटोनेली ने ऊँचाई पर स्थित ऑटोड्रोमो हरमनोस रोड्रिगेज़ में फ़िनिश लाइन पार करते ही टीम रेडियो पर खुशी से रो पड़े। अब कुल अंकों में उनकी बढ़त 119 अंकों की हो गई है, जिसे पार करना असंभव है।

- Ferrari's Lewis Hamilton started from pole position and took a close second place — after clashing with teammate Charles Leclerc — on an afternoon of drama with two safety cars, multiple crashes and an agonising 33-minute halt with 25 of the 71 laps remaining.

फ़ेरारी के लुईस हैमिल्टन ने पोल पोज़िशन से शुरुआत की और करीबी मुकाबले में दूसरा स्थान हासिल किया— हालाँकि इस दौरान उनकी टीम के साथी चार्ल्स लेक्लेर से टक्कर हुई। रोमांच से भरी दोपहर में दो बार सेफ़्टी कार आई, कई दुर्घटनाएँ हुईं और 71 में से 25 लैप शेष रहते रेस 33 मिनट तक रुकी रही।

- The previous youngest champion was Germany's Sebastian Vettel, who took the first of his four with Red Bull at 23 years and 134 days in 2010.

इससे पहले सबसे युवा चैंपियन जर्मनी के सेबास्टियन वेटेल थे, जिन्होंने 2010 में 23 वर्ष और 134 दिन की उम्र में रेड बुल के साथ अपने चार खिताबों में से पहला जीता था।

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- Verstappen went second in the overall standings, with Hamilton third and pre-season favourite George Russell plummeting to fourth and 130 points behind Antonelli.
  कुल अंकतालिका में वेरस्टैपेन दूसरे और हैमिल्टन तीसरे स्थान पर पहुँच गए, जबकि सीज़न शुरू होने से पहले खिताब के प्रबल दावेदार माने जा रहे जॉर्ज रसेल लुढ़ककर चौथे स्थान पर आ गए और एंटोनेली से 130 अंक पीछे रह गए।

The results:
नतीजे:

1. Max Verstappen (Red Bull) 2h: 20m: 28.772s;
2. मैक्स वेरस्टैपेन (रेड बुल) 2 घंटे, 20 मिनट, 28.772 सेकंड;
3. Lewis Hamilton (Ferrari) + 0.799,
4. लुईस हैमिल्टन (फ़ेरारी) + 0.799 सेकंड,
5. Kimi Antonelli (Mercedes) 4.006;
6. किमी एंटोनेली (मर्सिडीज़) 4.006 सेकंड;
7. Charles Leclerc (Ferrari) 10.707;
8. चार्ल्स लेक्लेर (फ़ेरारी) 10.707 सेकंड;
9. Lando Norris (McLaren) 11.778;
10. लैंडो नॉरिस (मैकलारेन) 11.778 सेकंड;
11. George Russell (Mercedes) 12.263;
12. जॉर्ज रसेल (मर्सिडीज़) 12.263 सेकंड;
13. Oscar Piastri (McLaren) 19.475;
14. ऑस्कर पियास्त्री (मैकलारेन) 19.475 सेकंड;
15. Franco Colapinto (Alpine) 20.204;
16. फ़्रैंको कोलापिंटो (अल्पाइन) 20.204 सेकंड;
17. Liam Lawson (Racing Bulls) 20.899;
18. लियाम लॉसन (रेसिंग बुल्स) 20.899 सेकंड;
19. Pierre Gasly (Alpine) 21.483;
20. पियरे गैस्ली (अल्पाइन) 21.483 सेकंड;
21. Gabriel Bortoleto (Audi) 22.041;
22. गैब्रिएल बोर्तोलेतो (ऑडी) 22.041 सेकंड;
23. Isack Hadjar (Red Bull) 22.503;
24. इसाक हदजार (रेड बुल) 22.503 सेकंड;
25. Ryo Hirakawa (Haas) 25.373;
26. रियो हिराकावा (हास) 25.373 सेकंड;
27. Alexander Albon (Williams) 27.562;
28. अलेक्ज़ेंडर अल्बोन (विलियम्स) 27.562 सेकंड;
29. Carlos Sainz (Williams) 28.638;
30. कार्लोस सैंज़ (विलियम्स) 28.638 सेकंड;
31. Nico Hulkenberg (Audi) 29.977;
32. निको हुल्केनबर्ग (ऑडी) 29.977 सेकंड;
33. Sergio Perez (Cadillac) 30.695.
34. सर्जियो पेरेज़ (कैडिलैक) 30.695 सेकंड।

DNF
: Arvid Lindblad (Racing Bulls); Oliver Bearman (Haas); Valtteri Bottas (Cadillac); Lance Stroll (Aston Martin); Fernando Alonso (Aston Martin).
रेस पूरी नहीं की: अरविड लिंडब्लैड (रेसिंग बुल्स); ओलिवर बियरमैन (हास); वाल्टेरी बोटास (कैडिलैक); लांस स्ट्रोल (एस्टन मार्टिन); फ़र्नांडो अलोंसो (एस्टन मार्टिन)।

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Standings:
अंकतालिका:

- **Drivers:** 1. Antonelli 380 pts.; 2. Verstappen 261; 3. Hamilton 259; 4. Russell 250; 5. Leclerc 245.
  ड्राइवर: 1. एंटोनेली 380 अंक; 2. वेरस्टैपेन 261; 3. हैमिल्टन 259; 4. रसेल 250; 5. लेक्लेर 245।
- **Constructors:** 1. Mercedes 630; 2. Ferrari 504; 3. Red Bull 380; 4. McLaren 371; 5. Racing Bulls 104.
  कंस्ट्रक्टर्स: 1. मर्सिडीज़ 630; 2. फ़ेरारी 504; 3. रेड बुल 380; 4. मैकलारेन 371; 5. रेसिंग बुल्स 104।

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