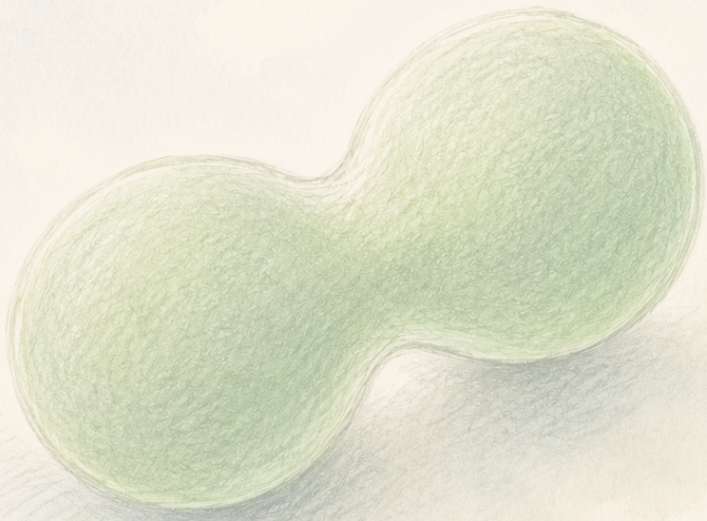


The Clean Paper

WHAT THE PAPER SAYS · WHAT IT DOESN'T · WHY IT MATTERS

Synthetic cell da ke feed, grow da divide — serious step, amma ba life built from scratch ba

University of Minnesota team ta report fatty droplet carrying ~90,000-base genome da ke feed, copy DNA, grow da divide across five generations, tare da introduced beneficial mutation spreading by selection. Genuine advance ne a building cells from defined purified parts. Amma ba peer-reviewed ba; ba zai make own protein machinery ko run own metabolism ba; parts purified biological molecules ne, ba simple chemicals assembled from scratch ba; kuma — a authors own words — selection ba spontaneous Darwinian evolution ba. Clean version ba "first living cell built from non-living matter" ba ne.

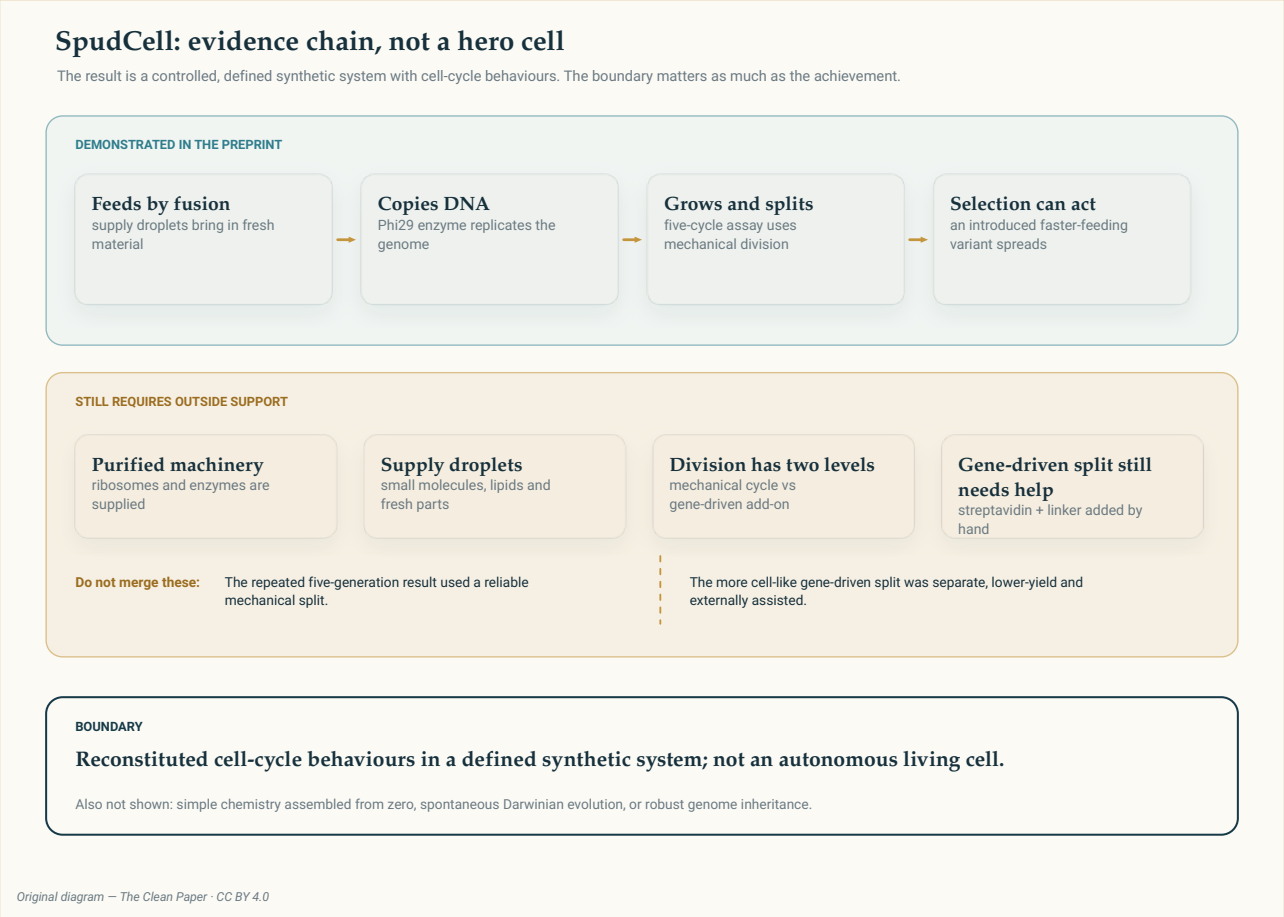
Written by Lucio Vaglio · Cross-checked by Laura Nesso · Edited by Michele Renda · Figures by Laura Nesso and Nova Vela · AI-assisted, human-reviewed

Paper: *A Chemically Defined Synthetic Cell Capable Of Growth And Replication*, Nathaniel J. Gaut, Christopher Deich, Brock Cash, Tanner Hoog, Aaron E. Engelhart, Katarzyna P. Adamala, Preprint (not peer-reviewed) — University of Minnesota

Labarin “ƙwayar halitta ta wucin-gadi ta farko,” idan aka cire hayaniyar kanun labarai

Kanun labaran sun yi girma sosai: ƙwayar halitta ta wucin-gadi ta farko a duniya mai cikakken zagayen rayuwa, rayuwa da aka gina daga abubuwan da ba su da rai, har ma da “lokacin Sputnik” ga ilimin halittu. Amma takardar da ke ƙarƙashin waɗannan kalmomi ta fi nutsuwa — kuma a zahiri ta fi ban sha’awa. Wata ƙungiya a University of Minnesota ta bayyana wata ƙaramin ɗigon mai da ake gani da madubin ƙara girma — irin kumfar mai da bangon ƙwayoyin halitta yake kama da ita — wadda ke ɗauke da umarnin gado. Ɗigon zai iya samun abinci ta hanyar haɗuwa da ƙananan ɗigon kayan abinci, ya kwafi umarnin, ya girma, sannan ya rabu ya zama ɗigon ’ya’ya, a zagaye da dama. A wani gwaji, wani sauyin da ke taimaka wa ɗigon ya girma da sauri ya bazu cikin yawan ɗigon, domin masu ɗauke da shi suna hayayyafa da sauri.

Wannan ci gaba ne na gaske, amma a ma’ana takamaimai: an gina wani tsari mai kama da ƙwayar halitta daga ƙasa zuwa sama, daga sassa da aka san su, sannan aka sa muhimman matakan zagayen ƙwayar halitta su yi aiki tare a wuri guda. Amma aikin har yanzu **preprint** ne da bai bi bitar takwarori ba. Kuma, kamar yadda marubutan da kansu suka bayyana, ba wata halitta ce da take iya dogaro da kanta ba, kuma ba juyin halittar Darwin da ya taso da kansa ba ne. Taƙaitaccen bayanin da ya fi dacewa ba “an halicci rayuwa daga babu” ba ne. Shi ne: a karon farko, masu bincike sun sa dukan jerin matakan zagayen ƙwayar halitta su yi aiki a cikin ɗigon wucin-gadi da aka tsara gaba ɗaya, ta amfani da sassan halittu da aka tsarkake.



Jerin shaidu ne, ba “jarumar ƙwayar halitta” guda ba. Layin sama yana nuna abin da takardar **ta tabbatar**: ɗigon

da aka tsara wanda yake samun abinci, yana kwafin kwayoyin gadonsa, yana girma kuma yana rabuwa a tsararraki biyar, tare da wani sauyi mai amfani da masu bincike suka saka yana yaɗuwa ta hanyar zaɓi. Layin tsakiya yana nuna abin da har yanzu yake **karɓa daga waje**: ribosomes da enzymes da aka tsarkake, ɗigon kayan abinci, da — wajen rabuwar da kwayoyin gado ke sarrafawa — wasu sinadarai da aka ƙara da hannu. Layin ƙasa shi ne **iyaka**: an sake gina halayen zagayen ƙwayar halitta a cikin tsarin wucin-gadi da aka ayyana sosai; ba ƙwayar halitta ce mai rai da ke iya dogaro da kanta ba, kuma ba juyin halitta da ya taso da kansa ba ne.

Original diagram — The Clean Paper CC BY 4.0

Abin da marubutan suka yi

Da farko akwai kwantena. "Ƙwayar halittar" wucin-gadin **liposome** ce — ɗigon da wani siririn bangon mai irin wanda yake kewaye ƙwayoyin halitta na gaske ya lullube. A ciki, ƙungiyar ta saka abubuwa biyu: umarnin kwayoyin gado da kuma ƙaramin tsarin da zai karanta waɗannan umarnin ya gina sunadarai.

Umarnin ya ƙunshi kwayoyin gado masu kusan **haruffan DNA 90,000** (90 kbp), an raba su zuwa ƙananan zobe bakwai da ake kira plasmids. Kayan gina furotin kuwa ba a ƙirƙire shi daga babu ba. Haɗin sassa ne na halittu da aka **tsarkake kuma suke aiki** — ribosomes, enzymes da sauran na'urorin samar da furotin — waɗanda aka haɗa da adadin da aka san shi. A fannin ana kiran wannan haɗin da aka sake tarawa kuma aka ayyana cikakke **PURE**. A nan "chemically defined" yana nufin cewa an san kowane sinadari da adadinsa, ba cewa an gina komai daga ƙananan sinadarai marasa rai ba.

Da wannan ɗigon, marubutan suka nuna cewa ana iya gudanar da manyan matakan zagayen ƙwayar halitta. Sun haɗa abubuwa huɗu.

Na farko, sun sa ɗigon ya **samu abinci da kansa**. Yana karɓar sabbin kayan aiki ta hanyar haɗuwa da ƙananan liposomes na abinci. Furotin da yake ba da damar wannan haɗuwar, ɗigon da kansa yake ginawa daga umarnin kwayoyin gadonsa. Saboda haka kwayoyin gado ne suke kunna tsarin ciyarwa, ba mai gwaji ne yake ƙara furotin da hannu a kowane zagaye ba.

Na biyu, sun sa shi **kwafi DNA ɗinsa**, ta amfani da wani enzyme na ƙwayar cuta mai suna Phi29 wanda aka rubuta umarninsa a cikin kwayoyin gadon.

Na uku, sun sa shi **girma ya kuma rabu** — kuma sun yi rabuwar ta hanyoyi biyu, bambancin da daga baya ya zama mai muhimmanci.

Na huɗu, sun nuna **zaɓi**. Sun saka wani sauyi a kwayoyin gado wanda yake sa ɗigon samun abinci da girma cikin sauri, sannan suka nuna cewa waɗannan ɗigon masu sauri sun fi sauran barin 'ya'ya kuma suka mamaye yawan ɗigon, musamman idan abinci ya yi ƙasa.

Abin da suka gano

Dukan zagayen yana iya tafiya tare. A cikin "tsararraki" biyar, ɗigon sun samu abinci, sun kwafi DNA, sun girma, sannan suka rabu a matsayin jerin matakai da ake maimaitawa, ba gwaje-gwaje dabam-dabam da aka nuna

sau ɗaya ba. Samun waɗannan matakai su yi aiki tare a cikin tsarin da aka ayyana sosai, kuma a haɗe da bayyanar kwayoyin gado na ɗigon, shi ne babban sakamakon takardar.

Kwayoyin gado za su iya sarrafa samun abinci da rabuwar ɗigon. Ɗigon zai iya samar da furotin da yake taimaka masa samun abinci. A wani gwaji dabam, wanda sakamakonsa ya fi ƙasa kuma har yanzu yana buƙatar wasu sinadarai daga waje, zai iya samar da furotin da ke taimaka masa rabuwa. Wannan mataki ne zuwa tsarin da umarninsa na ciki ke tafiyar da shi, maimakon ya dogara gaba ɗaya ga hannun mai gwaji.

Sauyi mai amfani yana iya yaɗuwa ta hanyar zaɓi. Wani nau'i mai "maɓallin kunnawa" mafi ƙarfi ga furotin ciyarwa — promoter mai aiki fiye da na asali — yana girma da sauri, yana barin 'ya'ya da yawa, kuma idan abinci ya yi kaɗan yana rinjayar nau'in farko. Wannan haɗi ne na gaske tsakanin sauyin kwayoyin gado da nasarar hayayyafa a cikin tsarin wucin-gadi.

Gado bai zama cikakke ba. Bayan tsararraki biyar, ƙalilan ne daga cikin ɗigon da aka bincika suka ci gaba da ɗauke da dukan zoben DNA bakwai. Rarraba dukan kwayoyin gadon daidai ga ɗigon 'ya'ya har yanzu ba abin dogaro ba ne.

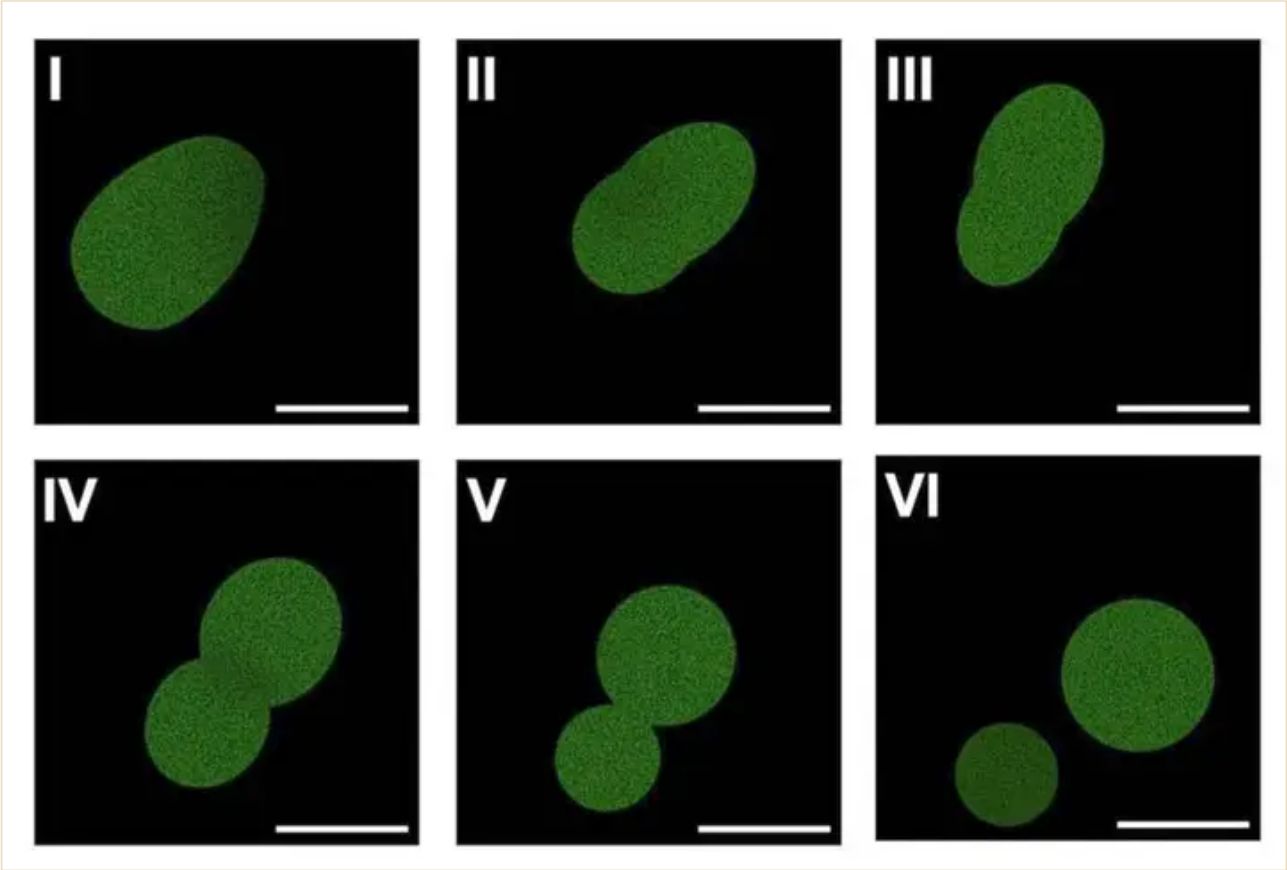
Abin da yake tafiya da kansa — da abin da ba ya yi

Kalmar da ta fi ɗaukar nauyi a kanun labarai ita ce *cikakke*. A takardar, "cikakken zagayen ƙwayar halitta" yana nufin matakan aiki — samun abinci, kwafin DNA, girma da rabuwa — an sake gina su kuma an auna su tare. Ba yana nufin ƙwayar halittar tana iya dogaro da kanta ba. Iyakoki biyu suna da muhimmanci, kuma marubutan sun bayyana su duka.

Na farko, tsarin **ba zai iya gina kayan aikin samar da furotin nasa ba**. Ribosomes da yawancin enzymes ana samar da su daga waje: an tsarkake su tun da farko sannan aka saka su cikin tsarin. A bayanin marubutan, ɗigon yana da ƙaramin tsarin metabolism sosai kuma ba zai iya gina ribosomes ba; samun cikakken 'yancin metabolism zai buƙaci kwayoyin gado masu girma ƙwarai. Saboda haka ɗigon yana iya tafiyar da zagayen ƙwayar halitta, amma ba ya gina dukan sinadaransa daga tushe da kansa.

Na biyu, rabuwar da ake amfani da ita kullum a gwajin **ta inji ce**. A gwajin tsararraki biyar, ana raba ɗigon ne ta hanyar tura su cikin matatar da ramukanta ƙanana ne — hanyar da aka zaɓa domin tana samar da ɗigon 'ya'ya cikin aminci. Rabuwar da ta fi kama da ta ƙwayar halitta ta gaske, inda furotin da ɗigon ya samar daga kwayoyin gadonsa ke taimaka wa rabuwar, an nuna ta ne a gwaji dabam. Tana buƙatar ƙarin sinadarai daga waje — streptavidin da wani mahaɗi — kuma nasararta ta fi ƙasa. Marubutan sun bayyana cewa har yanzu ana buƙatar hanyar rabuwa da ta fi ƙarfi, mai yawan nasara kuma mai sauƙin sarrafawa, watakila ta hanyar wani tsarin ƙashi na ciki da wannan ɗigon bai da shi yanzu.

Shi ya sa hoton ya ware hanyoyin rabuwa biyu. Zagayen tsararraki biyar da ake yawan ambata ya yi amfani da rabuwar inji; rabuwar da kwayoyin gado ke taimakawa wani ƙarin gwaji ne mai alƙawari amma mai rauni.



Jerin hotunan fluorescence microscopy daga preprint da marubutan suka karɓi bakuncinsa, yana nuna ƙwayar wucin-gadi tana tsawaita sannan tana rabuwa ta zama ɗigo biyu a gwajin rabuwar da kwayoyin gado ke sarrafawa. An nuna hoton a ƙaramin ƙuduri a karƙashin fair use domin sharhi kan sakamakon rabuwar; babban zanen jerin shaidu a sama ya ware wannan gwajin daga rabuwar inji da aka yi amfani da ita a gwajin tsararraki biyar.

Kate Adamala, Adamala Lab Fair use

Zaɓi ne, ba juyin halitta da ya taso da kansa ba

Sakamakon zaɓin yana da kyau kuma ya dace a faɗe shi daidai. Sauyin da yake da amfani — maɓallin kunna tsarin ciyarwa mafi ƙarfi — yana sa ɗigon girma da sauri, saboda haka yana barin ’ya’ya da yawa, saboda haka sauyin yana yaɗuwa. Wannan **zaɓi ne na gaske** da yake aiki a kan bambancin da za a iya gada.

Amma sauyin bai *taso da kansa* ba. Masu binciken ne suka saka shi. Kamar yadda marubutan suka bayyana, wannan maye gurbin mai amfani bai bayyana ba da kansa a cikin yawan ɗigon; an shigar da shi ne da gangan, kuma wannan ya bambanta da juyin halittar Darwin na halitta. Barin sauye-sauye su taso da kansu suna kiransa aikin gaba. Saboda haka: zaɓi da gasa kan albarkatu, eh. Juyin halitta mai buɗe hanya da yake samar da sabbin sauye-sauye da kansa, ba tukuna ba.

Abin da wannan bai tabbatar ba

- **Bai nuna ƙwayar halitta da aka gina daga sinadarai marasa rai ba.** Sassan da aka yi amfani da su sassan halittu ne da aka tsarkake — ribosomes da enzymes daga halittu masu rai, da enzyme na ƙwayar cuta — sannan aka haɗa su cikin ɗigon da aka ayyana. "Chemically defined" yana nufin an san abubuwan da aka saka, ba cewa an samar da su daga tushe marar rai ba. Hoton farko na takardar da kansa ya bayyana cewa an haɗa ƙwayoyin ne daga sassan halitta na halitta da aka tsarkake ɗaya bayan ɗaya.
- **Bai nuna halitta mai iya dogaro da kanta ba.** Tsarin ba zai iya gina ribosomes nasa ko tafiyar da metabolism nasa gaba ɗaya ba; yana dogara da kayan aikin da aka tanada da kuma ɗigon abinci.
- **Bai nuna juyin halitta da ya taso da kansa ba.** Masu binciken ne suka saka maye gurbin mai amfani.
- **Bai nuna gadon kwayoyin halitta mai ƙarfi ba.** Bayan tsararraki biyar, ƙalilan ne suka riƙe dukan kwayoyin gadon.
- **Bai nuna rabuwar da ƙwayar ke sarrafawa a matsayin hanyar yau da kullum ba.** Zagayen tsararraki biyar ya dogara da rabuwar inji; rabuwar da kwayoyin gado ke taimakawa tana da ƙarancin nasara kuma tana buƙatar taimako daga waje.
- **Ba a yi bitar takwarori ba.** Wannan preprint ne. Rahoton Science ya ce Cell ya ƙi aikin, kuma ana cewa ana ci gaba da bitarsa a wani wuri. Ya kamata a ɗauki takamaiman lambobin a matsayin na wucin-gadi.

Yaya ƙarfin shaidar yake?

Ga babban da'awar injiniya, shaidar kai-tsaye ce kuma mai yawa. Marubutan sun nuna matakan zagayen ƙwayar halitta suna aiki tare a cikin ɗigon wucin-gadi da aka ayyana, suna da alaƙa da bayyanar kwayoyin gadon tsarin, kuma ana maimaita su a zagaye da dama. Da'awar tana da iyaka, ana iya gwada ta, kuma an tallafa mata da gwaje-gwaje masu adadi, ko da yake aikin har yanzu preprint ne.

Rashin 'yancin metabolism da rashin juyin halitta da ya taso da kansa bai kamata a ɗauke su a matsayin da'awoyi da suka gaza ba. Marubutan ba su ce tsarin yana da waɗannan ƙwarewar ba; sun bayyana su a matsayin abubuwan da babu su yanzu ko manufofin aikin gaba. Iyakoki ne kan abin da "cikakken zagayen ƙwayar halitta" yake nufi a nan, ba hujja ce da ke rushe sakamakon da aka bayar ba.

Babban rashin tabbas saboda haka ba "shin sun ƙirƙiri rayuwa mai cin gashin kanta?" ba ne. Tambayar ita ce yadda sakamakon injiniyan zai tsaya idan aka yi bitar takwarori da maimaitawa a wasu dakunan gwaje-gwaje. Har sai wannan ya faru, ya dace a ɗauki adadin tsararraki, kaso na ɗigon da ke riƙe da dukan kwayoyin gadon, da yawan nasarar rabuwa a matsayin na wucin-gadi. Babban amincewa ya dace da haɗa matakan zagayen ƙwayar halitta; ƙasa da haka ga takamaiman ƙididdigar inganci; kuma da'awar "rayuwa," "dogaro da kai" ko "juyin halitta da kansa" ba sa cikin abin da binciken ya gwada.

Abin da labarin da aka gabatar wa jama'a ya ƙara — da dalilin da ya sa hakan yake da muhimmanci

A nan bambanci mai ban sha'awa ba tsakanin takardar da gaskiya ba ne. Yana tsakanin **takardar** da **kunshin labarin da aka gina a kusa da ita**. Rubutun binciken kansa yana taka-tsantsan da wannan iyaka; haɗarin wuce gona da iri yana bayyana ne idan aka rage sakamakon zuwa "ƙwayar halitta mai rai," "ƙwayar da ke iya dogaro da kanta," ko "rayuwa daga tushe." Gyara irin waɗannan kanun labarai ba daidai yake da rage darajar takardar saboda da'awar da ba ta yi ba.

Harshen rubutun binciken yana da auna. Yana kiran aikin mataki zuwa gano mafi ƙarancin abubuwan da rayuwa take buƙata, wata yiwuwar "chassis" ga tsarin gaba, da "tushe ga halittu na wucin-gadi gaba ɗaya." Kuma yana sanya manyan aikace-aikace da kalmomi kamar *a ƙarshe* da *mai yiwuwa*. Sanarwar University of Minnesota kuwa ta fara da "ƙwayar halitta ta wucin-gadi ta farko a duniya mai cikakken zagayen rayuwa" wadda "za ta iya kawo sauyi" ga ilimin halittu, ta kuma bayyana ƙwayar a matsayin wadda aka gina daga abubuwan da ba su da rai sannan ta jero yiwuwar amfani a magani, kayan masana'antu da sauran fannoni. Iyakokin suna cikin sanarwar — amma sun zo bayan an riga an kafa labarin "babban ci gaba," inda ba sa iya rage tasirin farko sosai.

Ba sai an ɗauka cewa an yi hakan da mugun nufi ba. Raba sakamako kafin bitar takwarori na iya zama zaɓi mai ma'ana, har ma da amfani: yana ba sauran dakunan gwaje-gwaje damar duba hanya su yi ƙoƙarin maimaitawa da wuri, wanda shi ne dalilin da marubutan suka bayar. Kuma ƙin takarda daga mujalla mai suna ba yana nufin aikin mara kyau ne ba; sakamakon da yake da babban buri kuma mai haɗarin kuskure yana da wahalar samun wurin buga shi, yayin da tsoron wani ya riga ka wallafa sakamakon ma gaskiya ne.

Amma saboda sadarwar ta yi ƙarfi sosai kuma ta zo **kafin** bitar takwarori, bukatar daidaito ma tana ƙaruwa. Tsari ne yake da muhimmanci: sanarwar labarai ta fara da mafi girman fassara sannan ta ƙara iyakoki daga baya. Bayanin da ya fi tsabta ya kamata ya yi akasin haka: ya fara da shaidar da matsayin binciken, sannan daga baya ya yi magana kan buri. Wannan ɗabi'a ce da mai karatu zai iya ɗauka zuwa "babban ci gaba" na gaba, ba wannan labarin kaɗai ba.

Takaitaccen bayani

Wata ƙungiya a University of Minnesota ta bayyana wani tsarin ƙwayar halitta na wucin-gadi da aka ayyana sosai: ɗigon mai da ke ɗauke da kwayoyin gado masu kusan tushe 90,000 da kuma tsarin samar da furotin da aka tsarkake. Ɗigon yana samun abinci ta hanyar haɗuwa da ɗigon kayan abinci, yana kwafi DNA, yana girma sannan yana rabuwa a tsararraki biyar. Masu binciken sun kuma nuna cewa wani sauyin kwayoyin gado mai amfani da suka saka da kansu yana yaɗuwa ta hanyar zaɓi, kuma kwayoyin gadon ɗigon za su iya taimakawa wajen sarrafa samun abinci da rabuwa. Amma sassan da aka yi amfani da su sassan halittu ne da aka tsarkake, ba sinadarai marasa rai da aka gina daga tushe ba; tsarin ba zai iya gina ribosomes ko tafiyar da metabolism nasa gaba ɗaya ba; rabuwar yau da kullum a gwajin tsararraki biyar ta inji ce, yayin da rabuwar da kwayoyin gado ke sarrafawa tana da ƙarancin nasara kuma tana buƙatar sinadarai daga waje; maye gurbin mai amfani masu binciken ne suka saka; kuma gadon dukan kwayoyin gado bai zama abin dogaro ba. Aikin preprint ne kuma bai bi bitar takwarori ba.

Bincike ba tare da ƙarin gishiri ba

Abin da takardar ta nuna: Ɗigon wucin-gadi da aka ayyana sosai wanda yake samun abinci ta hanyar haɗuwar da furotin da kwayoyin gadonsa suka samar ke taimakawa, yana kwafi kwayoyin gadonsa na kusan 90 kbp, yana girma sannan yana rabuwa a tsararraki biyar; wani gwaji dabam na rabuwar da kwayoyin gado ke taimakawa; da zaɓin wani maye gurbi mai amfani da masu binciken suka saka, ciki har da gasa lokacin ƙarancin albarkatu.

Abin da har yanzu yake na wucin-gadi kafin bitar takwarori: Takamaiman adadin tsararraki, yawan nasarar rabuwa, kaso na ɗigon da ke riƙe da dukan kwayoyin gadon, da yadda tsarin zai maimaitu a wasu dakunan gwaje-gwaje.

Abin da bai nuna ba: Ƙwayar da aka gina daga sinadarai marasa rai; halitta mai dogaro da kanta; maye gurbi da ya taso da kansa ko juyin halittar Darwin mai buɗe hanya; ingantaccen gadon dukan kwayoyin gado; rabuwar da ƙwayar ke sarrafawa a matsayin hanyar yau da kullum; ko cewa aikace-aikacen magani, kayan masana'antu da sauran abubuwan da aka ambata a sanarwar sun kusa shirye.

Babban iyaka: Babu bitar takwarori tukuna; tsarin ba shi da 'yancin metabolism — ribosomes da enzymes ana samar da su daga waje; babban gwajin tsararraki biyar yana amfani da rabuwar inji; rabuwar da kwayoyin gado ke taimakawa tana buƙatar ƙarin sinadarai kuma nasararta ta fi ƙasa; gadon kwayoyin gado bai zama cikakke ba.

Yaya yawan amincewa ya kamata mai karatu ya yi? Babban amincewa mai ma'ana da babban sakamakon injiniya: marubutan sun sa muhimman matakan zagayen ƙwayar halitta su yi aiki tare a cikin ɗigon wucin-gadi da aka ayyana, ko da yake har yanzu ana jiran bitar takwarori. Matsakaici zuwa ƙaramin amincewa ga takamaiman lambobin tsararraki, rabuwar da gadon kwayoyin halitta har sai an yi bita da maimaitawa. Takardar ba ta ce tsarin mai rai ne, mai dogaro da kansa, ko mai juyin halitta da kansa ba; waɗannan iyakokin abin da aka gwada ne, ba sakamako marar ƙarfi ba. Matsayin da ya dace: babban mataki wajen gina tsarin ƙwayar halitta daga sassan da aka san su, ba ƙirƙirar rayuwa ba.

Sabuntawa bayan wallafawa

- **Karin bayani · 2026-07-23**

  An fayyace confidence framing: living, self-sufficient, da self-evolving cells suna outside paper claims, ba low-confidence findings ba. Assessment na central engineering result bai canza ba.

Majiyoyi

Gaut, Deich, Cash, Hoog, Engelhart & Adamala — 'A Chemically Defined Synthetic Cell Capable Of Growth And Replication', author-hosted preprint (not peer-reviewed), 2026
https://biotic.org

Science — news coverage of the synthetic-cell preprint (2026)
https://doi.org/10.1126/science.zwa8dvz

University of Minnesota — press release

https://twin-cities.umn.edu/news-events/worlds-first-synthetic-cell-complete-life-cycle-could-revolu