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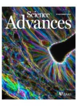

SCIENCE ADVANCES

VOLUME 12 | ISSUE 46 | 13 NOV 2026

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ONLINE COVER: Section of a mouse neural tube stained with phalloidin to visualize filamentous actin protein. The formation of pathway-specific cytonemes, actin-based “highways” that guide delivery of morphogen and growth factor signals to distant target cells, remains largely undefined. Daly *et al.* analyzed the development of Sonic Hedgehog cytonemes and signaling...
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The persistent multidomain health effects of the early-life exposome

BY AUGUSTO ANGUITA RUIZ, INES AMINE, CHONGLIANG LUO, ALICIA GUILLIEN, MARÍA ARTEAGA, ADRIÀ SETÓ-LLORENS, NIKOS STRATAKIS, LEA MAITRE, NURIA GÜIL-OUMRAIT, MARINA RUIZ-RIVERA, [...] VALÉRIE SIROUX +21 authors • 13 NOV 2026

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Symmetry as a common origin of hierarchical emergence and abstraction

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Lynx1 suppression reopens the window for effective rehabilitation after stroke in mice

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The role of network connectivity and transcriptomic vulnerability in shaping gray matter atrophy in multiple sclerosis

BY MAR BARRANTES-CEPAS, MARIO TRANFA, DAVID R. VAN NEDERPELT, ISMAIL KOUBIYR, LUIGI LORENZINI, BIRGIT HELMLINGER, STEFAN ROPELE, DANIELA PINTER, CHRISTIAN ENZINGER, TOMAS UHER, [...] GIUSEPPE PONTILLO +7 authors • 11 NOV 2026

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Input-specific deployment of the active zone scaffold RIM tunes synaptic release probability and plasticity

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Neuromelanin-inspired metal-selenomelanin nanonetworks restore neuronal excitability in radiation-induced brain injury

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Incomplete synaptic vesicle priming functionally disconnects CA1 pyramidal cells

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EARTH, ENVIRONMENTAL, ECOLOGICAL, AND SPACE SCIENCES

Basin-scale changes in net primary production from the biogeochemical-Argo array

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Origins of low density and low accretion rate in classical T Tauri stars

BY GUIYUN LIANG, HUIGANG WEI, DAWEI YUAN, JIAYONG ZHONG, ZUOLIN MA, YONGLI PING, LIFENG WANG, JUN XIONG, ZHIYONG XIE, XINWEN MA, [...] GANG ZHAO +1 authors • 13 NOV 2026

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The Azores plume origin of the New England Seamounts chain

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Superoxide dismutase shapes manganese stoichiometry in Southern Ocean diatoms

BY J. SCOTT P. MCCAIN, LOAY J. JABRE, ELDEN ROWLAND, JINYOUNG JUNG, YOUNGJU LEE, TAE-WAN KIM, CORINA P. D. BRUSSAARD, ROB MIDDAG, ERIN M. BERTRAND • 11 NOV 2026

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High-precision ^{81}Kr dating overcomes radiocarbon limits in Late Pleistocene groundwater

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A primordial heavy water reservoir in the outer solar system

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Increases in Northern Hemisphere winter circulation waviness over 1989 to 2011 driven by decadal oceanic variability

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ABSTRACT

Discovery of a likely supermassive neutron star in a remarkably wide binary

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Brown carbon in biomass burning aerosol enhances HONO production

BY FENGXIA BAO, LUCIA IEZZI, WENJIE WANG, ARIANNA TRONCONI, YANFANG CHEN, THERESE S. CARTER, COLETTE L. HEALD, KASPAR RUDOLF DÄLLENBACH, DAVID M. BELL, MARKUS AMMANN • 11 NOV 2026

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Physics-informed and data-efficient machine learning for storm surge forecasting during typhoons

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An end-to-end machine-learning system for global eddy-resolving ocean forecast

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Raising mountains for a habitable Earth

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Weak adsorption, strong consequences: How trace gases control ice growth and quasi-liquid-layer structure

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A LiDAR-based reconstruction reveals increasing Arctic phytoplankton production during low-light winter-shoulder period

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Upper plate structure controls nearshore subduction mechanics in Cascadia

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PHYSICAL AND MATERIALS SCIENCES

Fault-tolerant quantum computing with high-rate symplectic double codes

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Molecular thermal vibration assisted 1208-nm excitable photon upconversion with large anti-Stokes shifts

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Nonlinear cooling and control of a mechanical quantum harmonic oscillator

BY MATTEO SIMONI, IVAN ROJKOV, MATTEO MAZZANTI, WOJCIECH ADAMCZYK, ALEXANDER FERK, PAVEL HRMO, SHREYANS JAIN, TOBIAS SÄGESSER, DANIEL KIENZLER, JONATHAN HOME • 11 NOV 2026

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Reprogramming electron transfer at single-atom Pt sites to break the interference barrier in uric acid detection

BY YIFEI CHEN, MENGXUE ZHU, YINJUN TANG, ZHENGYI CHEN, JINGXIN CHANG, RUIMIN LI, HAIFEI WAN, QIE FANG, WENHONG YANG, WENXUAN JIANG, [...] CHENGZHOU ZHU +4 authors • 11 NOV 2026

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A fully hydrogel implantable patch for in situ ultrasonic monitoring of gastric leakage

BY YE TIAN, NA LI, ZHANGQI PAN, JIAXIN WANG, QIYUN HU, ZHENG DAI, XUDONG XU, YUEYING YANG, SENDONG ZHANG, XINGUO LAN, [...] JIANFENG ZANG +6 authors • 11 NOV 2026

ABSTRACT

Deep learning–assisted electron microscopy for apparent Z-height mapping of atomically dispersed catalysts

BY XIAOCANG HAN, YUAN MENG, QILONG CAI, YANHUI HONG, ZANLIN QIU, WEIWEI HU, SHU MIAO, KANGSHU LI, JUN ZHAO, FANQI MENG, [...] XIAOXU ZHAO +4 authors • 13 NOV 2026

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Segmented projection image translation for large-area, high-resolution vat photopolymerization

BY JIZE DAI, JASON M. KRONENFELD, DAN ILYN, CHRISTOPHER LINHARDT, PHILIP R. ONFFROY, IAN A. COATES, COLIN CROWN, MICHELLE CHEN, JACOB DOBSON, MAX A. SACCONE, [...] JOSEPH M. DESIMONE +2 authors • 11 NOV 2026

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When and how particles are removed by drops

BY ABHINAV NAGA, FRANZISKA SABATH, DORIS VOLLMER, HALIM KUSUMAATMAJA • 13 NOV 2026

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Real-time complex-valued RF blind source separation via in-physics computing

BY JIAJIA WANG, SHURAN ZHANG, HAORAN ZHANG, YIFU XU, SHIFAN CHEN, PEIMING YAN, ZHIHUI LIU, XIAOTIAN ZHU, SHUYING LI, YUYANG LIU, [...] KUN XU +7 authors • 11 NOV 2026

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Swarm-inspired magnetic metal-organic framework-based microbots for on-demand moisture manipulation

BY MINGREN CHENG, CHENYANG TUO, YIFAN LIANG, XINSHENG WANG, MOYUAN CAO, XIAN-HE BU • 13 NOV 2026

ABSTRACT

Carrier-free Arg-CpG augments antitumor efficacy by triggering specific immune activation

BY HUISHAN LI, QUANKUN LIN, YUEXIA XIE, XIAOZHEN HE, SHUAI YANG, YAN ZHOU, XUE ZHAO, XINGANG WANG, YONGMING HAN, FANGLI CAO, [...] PEIFENG LIU +2 authors • 13 NOV 2026

ABSTRACT

All-optical sensing of dermal activity enables an AI-powered wearable ring for continuous stress monitoring

BY MD FARHAD HASSAN, SHOUNAK DAS, DOLENDRA VIKAS ADDEPALLI, LEIKHANG XIONG, MOHAMMAD SHAFIQUL ISLAM, A. K. M. RAKIB, SAMIHA TASNIM, XIAO YU, EMILY RAWSON, MOHAMMED ARFAN, [...] YASSER KHAN +4 authors • 13 NOV 2026

ABSTRACT

Direct visualization of light’s polarization and spectrum with a compass-like meta-device

BY YIFENG XIONG, SHAOCHEN FANG, HAOTIAN XU, TIANYUE LI, XIANGYU MA, HONG ZHANG, YE CHEN, JINHUI CHEN, YU LEI, C. T. CHAN, FEI XU • 13 NOV 2026

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Battery-free ingestible electronic capsule with programmable high-output soft actuation for active gastrointestinal interventions

BY HUBIAO FANG, RAN XIE, XI JIANG, JIAQI ZHU, CHEN HE, KEXIN ZHANG, WEI TANG, HANJIE WANG, WENYAN ZHANG, QIFENG ZHU, [...] DONG HAN +5 authors • 13 NOV 2026

ABSTRACT

Electrical spin pumping in exchange-coupled molecules

BY PAUL GREULE, WANTONG HUANG, KWAN HO AU-YEUNG, MÁTÉ STARK, JOHANNES SCHWENK, CHRISTOPH SÜRGERS, WOLFGANG WERNSDORFER, PHILIP WILLKE 13 NOV 2026

ABSTRACT

Passive imaging with quantum advantage

BY LI GONG, AONAN ZHANG, MADHURA GHOSH DASTIDAR, ALEXANDER DUPLINSKII, A. I. LVOVSKY • 11 NOV 2026

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Pathology-targeted PET/CT imaging of early lupus nephritis via a ^{68}Ga-labeled single-stranded DNA probe

BY ZHIWEN HUANG, WENBO LI, MEIJIANG ZHOU, ZHIDIE HUANG, YINGYING WEI, ZHANGYI YIN, CHENXI YANG, ZIJUN MA, MIN SHEN, QUAN GONG, [...] JIXIN ZHONG +3 authors • 13 NOV 2026

ABSTRACT

Electronic hair: Transforming hair into a scalable bioelectronic interface

BY SHWETA SHWETA, MALAMATI GIOMPLIAKI, LINTA SOHAIL, RÉMY CORNUÉJOLS, PRESTON D. DONALDSON, TOBIAS ABRAHAMSSON, DINA KC, MARIA NTZOUNI, SILA YILDIZ CENGIZ, SOFIA DRAKOPOULOU, [...] GEORGE D. SPYROPOULOS +8 authors • 11 NOV 2026

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Multimodal switches exploiting electromechanical snap-through for versatile robotic information processing

BY SHENGJUN FAN, JIANGLONG GUO, FEI JIA, JIAN SUN, YANJU LIU, METIN SITTI • 11 NOV 2026

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Cocrystals for sequestering and separating large PAHs

BY MARÍA G. VASQUEZ-RÍOS, GONZALO CAMPILLO-ALVARADO, CHANGAN LI, KARIM NADER SAMRA, HERBERT HÖPFL, LEONARD R. MACGILLIVRAY • 11 NOV 2026

ABSTRACT

Dynamic plasmonic imaging of electromechanically driven nano-oscillators for charge-resolved multiplex biosensing

BY YUNXIAO WANG, XIAOYIN LIU, JINGYU WU, JINBIAO MA, BAIQI CUI, GUANGZHONG MA, JIANXIN MA, QINGJUN LIU, DI WANG, FENNI ZHANG • 11 NOV 2026

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Controllable fabrication of visible-spectrum 3D photonic crystals

BY HUACE HU, DAQIAN LI, HUI GAO, FAYU CHEN, MINGDUO ZHANG, ZONGJING LI, AOFEI MAO, WEI XIONG • 11 NOV 2026

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Boosting stability and charge transfer of conducting polymer poly(benzodifurandione) (PBFDO) through complementary topology

BY YUHAO GENG, BOWEN YAO, YUYAO LU, JINGCHENG LIU, ZIMO CHEN, SHANGCHENG ZOU, ZHAOYANG YIN, XUESONG HUANG, JIANLONG XU, JIAJUN FU 11 NOV 2026

ABSTRACT

Arbitrarily cuttable and ultrathin MXene structural colors for customizable and wearable multispectral information management

BY CHUNXIAO WU, HUHU CHENG, CHUANXIN WENG, CHEN LUO, QIHUA LIAO, KAIXUAN ZHU, YAJIE HU, LEILEI LIANG, BIN WANG, YAN LI, LIANGTI QU • 11 NOV 2026

ABSTRACT

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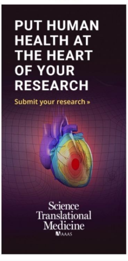
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Tellurium-assisted rapid synthesis of violet phosphorus via solid-phase thermal transformation

BY XINZE LIU, WUJIA CHEN, XINYU QI, QIANG LI, QINGFENG YAN • 13 NOV 2026

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Acid-promoted photocatalyzed C1-ketonylation of glycosyl benzoates, oxalates, and sulfides

BY YANG HAN, YUJUAN WANG, XINYAO XU, WANGSHU ZHU, BO YANG, FENG ZHU • 13 NOV 2026

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Time-evolved hetero-alkali interphases enable long-life sulfide-based anode-free solid-state batteries

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Integrating biomass production platform and identification approach for stereochemical assignment of super-carbon-chain compounds

BY FEN LIU, GE XU, HONG-YU CHEN, DING-MING LI, XIN-YU XIAO, ATTILA MÁNDI, JUN WU, KE-WU ZENG, TIBOR KURTÁN, LI SHEN • 11 NOV 2026

ABSTRACT

BIOMEDICINE AND LIFE SCIENCES

Noncanonical enhancers control gene expression and cell fate in human pluripotent stem cells

BY YANG CAO, OLEKSANDR DOVGUSHA, AYYUB EBRAHIMI, CARMELA RIELINE V. CRUZ, STEPHEN BEVAN, LUKAS WIDMER, FERESHTEH TORABI, JULIA KURLOVICH, IGNACIO RODRÍGUEZ-POLO, SOUMEN KHAN, [...] STEFAN SCHOENFELDER +5 authors • 13 NOV 2026

ABSTRACT

Microscale patchiness controls resource acquisition in populations of foraging bacteria

BY FRANCESCO CARRARA, DOUGLAS R. BRUMLEY, ANDREW M. HEIN, TIMOTHY COOPER, M. MEHDI SALEK, JOHANNES KEEGSTRA, SIMON A. LEVIN, ROMAN STOCKER 13 NOV 2026

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An LHX2-DACH1 regulatory innovation drives basal progenitor expansion in the primate neocortex

BY PEI-SHAN HOU, CHING-YU CHUANG, FENG-LAN CHIU, CHAN-HSIEN YEH, SHIH-SHUN HUNG, QUAN WU, TAEKO SUETSUGU, FUMIO MATSUZAKI, SHEN-JU CHOU, HUNG-CHIH KUO • 13 NOV 2026

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A TROP2-targeting aptamer enables selective drug delivery and potent antitumor activity in pancreatic cancer

BY YUANDING LIU, ZHAOFENG LUO, YUAN GAO, TAO PAN, CHANGJIE YANG, ZHENG ZHANG, DIE YU, YIFAN HE, DAIQUAN CHEN, SAINAN GUO, [...] WEIHONG TAN +2 authors • 11 NOV 2026

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Single-nucleus multiomic profiling uncovers epigenetic dysregulation driving hippocampal vulnerability in Alzheimer's disease

BY QUYUAN TAO, TING LUO, PAN WANG, MAORUI JIANG, ZILIN LAI, BUFAN JIN, YUYANG LIU, YOUZHE HE, YANRONG WEI, YUE GAO, [...] LEI HAN +8 authors 13 NOV 2026

ABSTRACT

Mechanical forces enable human stem cell modeling of protein aggregation cardiomyopathy

BY YASAMAN KARGAR GAZ KOOH, BAHAREH BAHMANI, CHEN ZHAO, GANESH MALAYATH, ANASTASIA KHOKHLOVA, LEAH HAYEM, HERTIER UMURAGWA, HANXUN JIN, GHISKA RAMAHDITA, XIANGJUN PENG, [...] NATHANIEL HUEBSCH +8 authors • 11 NOV 2026

ABSTRACT

Dual-action small-molecule VSP-51-2 ameliorates polycystic ovary syndrome via PPARγ modulation and AKR1C3 inhibition

BY XIAWEN LIU, XIUFEN ZHENG, LEI MA, ZIQING YAO, XUEHUA ZHENG, MIAO LIANG, XINHONG WU, SILIN ZHANG, XIANGLIN ZHOU, LEYING ZHU, [...] WEI YI +2 authors • 11 NOV 2026

ABSTRACT

Asymmetric cell division is predictive of human T cell vaccine responses

BY LIN LUO, URSULA K. DUEREN, ANA VICTORIA LECHUGA-VIECO, DIMITRA STAMKOPOULOU, LILIANA TCHERNEV, YAVUZ F. YAZICIOGLU, AMIR HOSSEIN KAYVANJOO, TERESA LAMBE, ANNA KATHARINA SIMON, MARIANA BORSA • 11 NOV 2026

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Aneuploidy impairs B cell development but accelerates their MYC-driven transformation

BY JOHANNES G. WEISS, PAUL Y. PETERMANN, IRENE RIGATO, MICHAEL LOHMÜLLER, FELIX HONOLD, MARINA SCHAPFL, SARAH SPÖCK, NADINE KINZ, ANDRÉA E. TIJHUIS, RENÉ WARDENAAR, [...] ANDREAS VILLUNGER +8 authors • 13 NOV 2026

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Ketogenic diets induce proinflammatory macrophage accumulation through long-chain saturated fatty acids driving cGAS-STING signaling

BY SUNG-JEN WEI, JOSEPH SCHELL, MAIKO SEZAKI, AGNE BASEVICIENE, WEI QIAN, WAN HSI CHEN, ROLANDO TREVINO JR, PRETHISH SREENIVAS, ESTRELLA SANDRA CHOCRON, HAIYAN JIANG, [...] DAVID GIUS +6 authors • 13 NOV 2026

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Inhibition of aberrant astrocyte activity restores auditory sensorimotor function in zebrafish *spen* mutants

BY YAN GAO, ANNA SHIPMAN, PENG SUN, NA ZHANG, ELIOT T. SMITH, ITALLIA PACENTINE, ALEX NECHIPORUK, TERESA NICOLSON • 11 NOV 2026

ABSTRACT

Identification of gamma-hydroxybutyrate (GHB)–β-ribose as a promising biomarker enabling prolonged detection of GHB intake

BY KATHRINE BOHN FALDBORG, JØRGEN BO HASSELSTRØM, LAMBERT KRISTIANSEN SØRENSEN, CAMILLA BAK NIELSEN, SØREN LAU BORCHER MØLLER, THOMAS B. POULSEN, MOGENS JOHANNSEN, CHARLOTTE UGGERHØJ ANDERSEN, KIRSTINE LYKKE NIELSEN • 13 NOV 2026

ABSTRACT

The transcription factors OsIDD and OsSHR jointly regulate ground tissue patterning and differentiation in rice roots

BY LIYUN PENG, ZHUFENG CHEN, ZIHENG LI, SHULING CAO, JINGE LIU, RUITING LIU, JINYU YU, BAOLEI ZHANG, XIAOYU LIANG, BOCHENG GAO, [...] JIXING XIA +1 authors • 11 NOV 2026

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The ZmJAZ14–ZmMYC2 module regulates anthesis–silking synchrony in maize

BY XIANGYU LU, DI LV, SHUAI MA, YU YAN, CHUNHUI LI, JIAMENG ZHU, LIQING MIAO, SUZHEN LI, WENZHU YANG, XIAOJIN ZHOU, RUMEI CHEN • 11 NOV 2026

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Decoding cancer therapy resistance through advanced 3D organoid systems

BY RUI YE, JIE WANG, WAN XU, YAN CHEN, ZHONGWEI ZHANG, YUPEI ZHANG, SHUGANG QIN • 13 NOV 2026

ABSTRACT

GEX1-mediated semigamy induces both maternal and paternal haploids in cotton

BY TENGYU LI, JINGWEN PAN, YAN LI, JINBO YAO, SHENGTAO FANG, ZONGPENG CAO, SHOUHONG ZHU, YONGSHAN ZHANG, WEI CHEN • 13 NOV 2026

ABSTRACT

ZSCAN4 links a transient reset of repetitive DNA to genome integrity and cellular plasticity

BY VALERIA LUCCI, ELENA AMENDOLA, FRANCESCO ALBANO, CARMEN RUOPOLO, GIUSEPPINA DI PAOLA, DANIELE BRAVOCO, CLAUDIA SABATO, GIUSEPPE CESTA, CARLO CALABRESE, GEPPINO FALCO, PELLEGRINO MAZZONE • 13 NOV 2026

ABSTRACT

H3K9 demethylase KDM3A potentiates interferon signaling and macrophage-driven inflammation in atherosclerosis

BY RICKY SIEBELER, HUNG-JEN CHEN, TATYANA KUZNETSOVA, ANNETTE E. NEELE, SASKIA VAN DER VELDEN, MARION J. J. GIJBELS, GUILLERMO R. GRIFFITH, CINDY P. A. A. VAN ROOMEN, KOEN H. M. PRANGE, MARIEKE C. S. BOSHUIZEN, [...] MENNO P. J. DE WINTHER +5 authors • 13 NOV 2026

ABSTRACT

Phototropin-mediated blue light signaling orients the asymmetry of *Marchantia polymorpha* spores

BY JOHANNES ROETZER, RADKA SLOVAK, EVA-SOPHIE WALLNER, NATALIE EDELBACHER, BEATE ASPER, SEBASTIAN DEIBER, SEBASTIAN SEITNER, MARTIN COLOMBINI, LIAM DOLAN • 11 NOV 2026

ABSTRACT

Cell adhesion molecule–related proteins signal to promote cytoneme elongation from Sonic Hedgehog–producing cells

BY CHRISTINA A. DALY, MIRIAM E. DILLARD, ERIC T. HALL, ALFONSO LAVADO, JONATHON KLEIN, JINBIN ZHAI, SHONDRA M. PRUETT-MILLER, VISHWAJEETH R. PAGALA, ANTHONY A. HIGH, ALEXANDRE F. CARISEY, [...] STACEY K. OGDEN +2 authors • 11 NOV 2026

ABSTRACT

NIR-enzymatic dual-engine nanomotors overcome cartilage matrix barriers and reprogram the osteoarthritic microenvironment

BY CONG XU, YUXIN ZHANG, YALIN HE, HAIYING LIANG, HONG WANG, YONGXI LONG, JINGYUE PAN, YICHENG YE, YUNSHI LI, YUEJUN JIANG, [...] YINGJIA LI +3 authors • 13 NOV 2026

ABSTRACT

MAIT cells exacerbate early liver fibrosis by downsizing the intrahepatic regulatory T cell compartment

BY NICOLE I. WANG, VALERYIA SHYDLOUSKAYA, ANGELA SCHINCAGLIA, KATELYN R. REID, AGETHA MAHENDRAN, DENISE CAO, BRIAN A. KELLER, SHEREEN Q. ZIA, AHMAD R. MOVASSEGHI, JULIUS HARUNA, [...] S. M. MANSOUR HAERYFAR +2 authors • 13 NOV 2026

ABSTRACT

Structural and biochemical insight into allosteric regulation of the human 2-aminoadipic semialdehyde synthase

BY RUOXI WU, SUSMITA KHAMRUI, TETYANA DODATKO, YUFEI XIANG, AFROOZ GOLESTANIAN, NGOC DUNG PHAM, KUNAL KUMAR, YI SHI, ROMAN OSMAN, ROBERT J. DEVITA, [...] MICHAEL B. LAZARUS +1 authors • 13 NOV 2026

ABSTRACT

Engineering exhaustion-resistance CD19 CAR T cells to address translational barriers for the treatment of cancer and autoimmune disease

BY AFREEN ASIF ALI SAYED, TIM CHAN, CHERYL G. BOLINGER, POOJA CHAUHAN, MARION CHAKIATH, CAROL POORTMAN, JACQUES PLUMMER, BERNWARD KLOCKE, ENAYAT NIKOOPOUR, AIFEN WANG, [...] SHAMIM AHMAD +8 authors • 13 NOV 2026

ABSTRACT

Single-cell profiling of the duodenum during chronic human norovirus infection

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ABSTRACT

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BY YEBIN PARK, GEUNHO KWON, JUNHO NOH, JAEHYUN LEE, KEUNSOO KANG, KYUNG-HYUN PARK-MIN, KYUHO KANG • 11 NOV 2026

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