
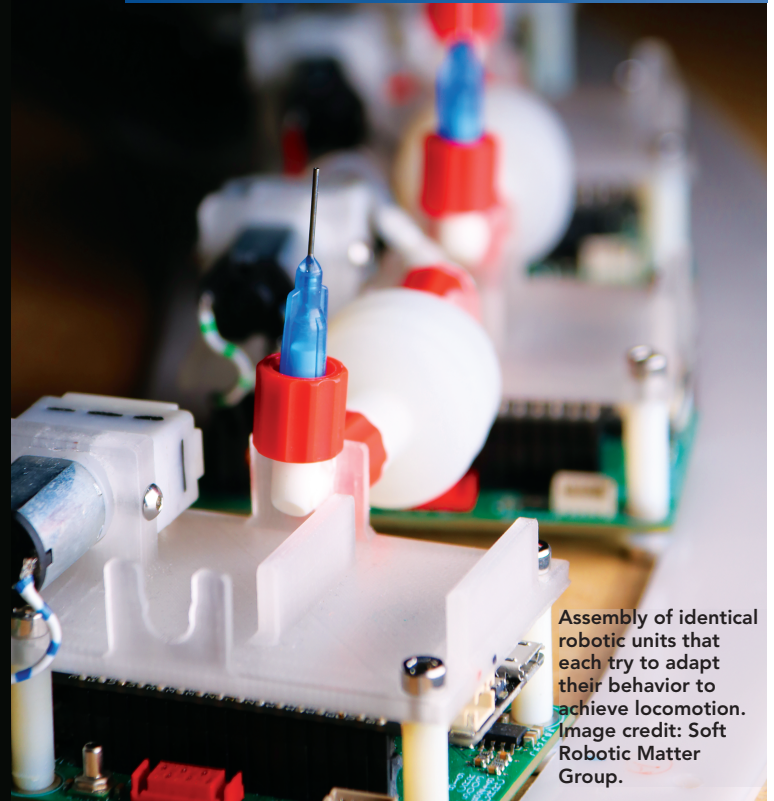


## ENGINEERING

### Autonomous robot learning

Imbuing robots with the ability to detect their environments and to adapt and behave autonomously under a range of conditions remains a challenge. Previous approaches have increased the complexity of the central controller or implemented machine learning. Giorgio Oliveri et al. developed and tested a modular robot, assembled from identical discrete units that individually and continuously sense and respond to their environment. The authors set the modular robot, programmed with a Monte Carlo scheme, on a circular track to see how it developed locomotion. The robot learned to move forward and achieved maximum speed after 80 seconds. In this and other experiments, the modules were able to maintain optimal behavior, even when sustaining damage, as long as their memory was made to represent the current environment. No communication between the modules except for a physical connection was needed, eliminating the need for a central controller. According to the authors, scaling up such an approach could result in robotic materials that could be miniaturized and autonomously learn to navigate environments for a range of applications in healthcare, disaster relief, and space exploration. — P.G.

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Assembly of identical robotic units that each try to adapt their behavior to achieve locomotion. Image credit: Soft Robotic Matter Group.

## EARTH, ATMOSPHERIC, AND PLANETARY SCIENCES

### Central-western Greenland Ice Sheet approaches a tipping point

The Greenland Ice Sheet (GIS) is losing mass at an accelerating rate due to climate change and has been predicted to melt entirely by 3000 AD under the worst-case scenario, potentially raising global sea level by more than 7 meters. Niklas Boers and Martin Rypdal estimated the stability of the central-western GIS by analyzing summer sea-level temperatures from stations and melt rates from a stack of ice cores, reconstructing ice sheet height, and using model simulations. The melt rate and ice sheet height fluctuations revealed early warning signals suggesting that this part of the ice sheet is approaching a critical transition. Additional results suggest that the physical

process underlying the early warning signals is the melt-elevation feedback—a cycle in which melting decreases ice sheet height, thereby exposing the surface to warmer temperatures and further accelerating melting. The findings suggest that the melt-elevation feedback is the dominant mechanism driving the ongoing destabilization of the central-western GIS in response to rising temperatures. According to the authors, the results suggest that this portion of the ice sheet will undergo significantly enhanced melting in the near future, highlighting the need to determine the stability of the entire GIS. — J.W.

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## ECOLOGY

### Climate change and declining coral reef growth

Ocean warming and acidification pose increasing threats to coral reefs and the calcium carbonate frameworks of

coral-rich biodiversity hotspots. Relatively little is known about the potential global impact of climate change on the net calcium carbonate production of coral reefs. Christopher Cornwall, Steeve Comeau, et al. analyzed data from 183 reefs worldwide to estimate the effects of ocean warming and acidification and modeled the size of the effects under three scenarios representing the range of future greenhouse gas emissions. Net carbonate production in every coral reef analyzed is expected to decrease under all three scenarios. The models predict that 63% of reefs will continue to grow in 2100 under the best-case scenario, but 94% of the reefs will be eroding by 2050 under the worse-case scenario. Under the two worse scenarios, declines in net carbonate production are projected to be so severe that reef growth will cease globally by 2100. The predicted declines are largely attributable to reduced coral cover due to bleaching events. According to the authors, rapid reduction of carbon dioxide emissions is needed to

protect coral reef ecosystems and their critical ecological functions. — J.W.

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PSYCHOLOGICAL AND  
COGNITIVE SCIENCES

## Mother's scent triggers face-selective neural responses in infants

Grouping objects into distinct categories is critical for interpreting the constant stream of sensory inputs from complex environments. However, the

developmental roots of this ability are obscure, and whether early-maturing senses, such as smell, facilitate the acquisition of categories in more slowly developing senses, such as vision, remains unclear. Diane Rekow et al. used electroencephalography to measure brain activity in 20 4-month-old infants who were shown a series of object images, including shapes that elicit the illusory perception of faces in adults, while being exposed to their mother's odor or a neutral odor. During the neutral odor condition, the face-like shapes elicited greater neural activity in the left and right occipitotemporal cortex, compared with the

other objects. However, during the maternal odor condition, the face-selective response was stronger and more extensive in the right occipitotemporal cortex. The results suggest that exposure to maternal odors, which are systematically associated with faces in infants' daily lives, initiates the categorization of face-like objects via activation of the right occipitotemporal cortex, which plays a dominant role in face categorization in adults. According to the authors, the right-hemisphere advantage for face categorization may emerge earlier than previously thought. — J.W.

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Crested pigeons on a fence.

ECOLOGY

## Global abundance of birds

Abundance estimates of fauna are important for research and conservation efforts. However, the abundance of bird species remains uncertain. Corey Callaghan et al. examined global occurrences and population estimates for approximately 92% of all extant bird species, using data that spanned 2010–2019. Overall, the authors report, there are approximately 50 billion individual birds in the world and the majority live in Palearctic and Nearctic biogeographic realms. Most bird species are rare, and 12% of species have population estimates of less than 5,000 individuals. Conversely, few bird species are abundant, and only the house sparrow, European starling, ring-billed gull, and barn swallow have an estimated global population of more than 1 billion individuals each. The authors also found that birds do not inherit abundance through speciation events, which is consequential for species' extinction risk. The most abundant orders of birds are perching birds, shorebirds, and waterfowl, whereas the least abundant orders are kiwis and mesites. Across feeding guilds, invertivores and omnivores are the most abundant groups of birds, whereas scavengers and nectarivores are the least abundant groups. The findings suggest that increased conservation efforts are necessary to maintain bird diversity, given that most bird species have few individuals, according to the authors. — M.S.

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Military training exercises using live ammunition often leave fields strewn with a contaminant known as RDX. Image credit: Shutterstock/Mikhail Starodubov.

### GENETICS

## Transgenic switchgrass cleans up contamination from military explosives

Posted on May 14, 2021

*Carolyn Beans*

At military sites in the United States and across the globe, routine live-fire trainings produce a downpour of an explosive known as RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine). A synthetic chemical, RDX can threaten human health, damaging the nervous system if inhaled or ingested. The EPA also classifies it as a possible human carcinogen. But removing the contaminant from military sites where it builds up over decades is no easy task. "It doesn't break down in the environment very readily," says plant biotechnologist Liz Rylott of the University of York in the United Kingdom. "It's in the groundwater and it is starting to threaten drinking water supplies."

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