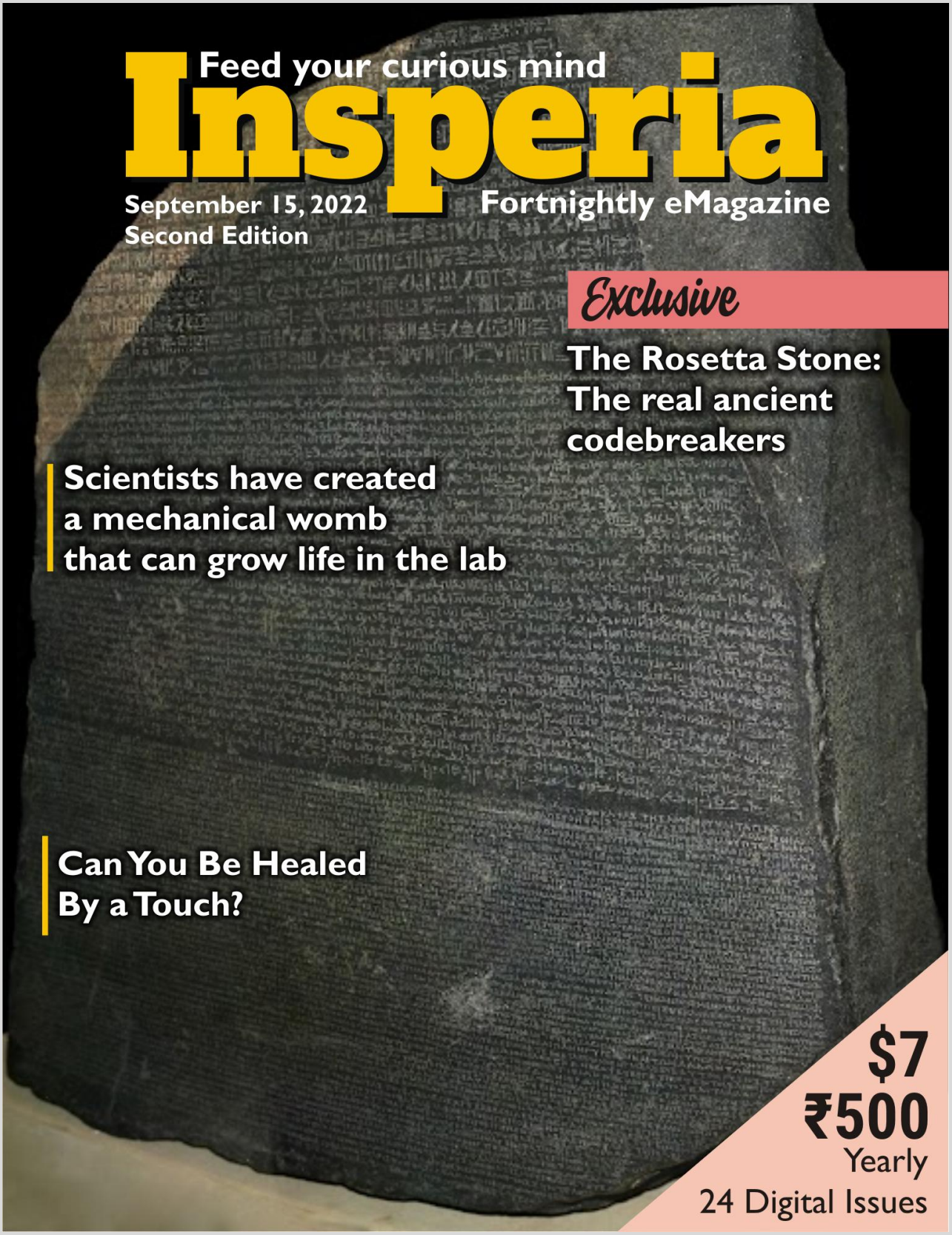
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# EDITOR'S DESK

## A Parent's Guide to Encouraging Self-Motivation for Kids

Give your kids a head start by teaching them self-motivation. While children have a natural sense of curiosity, intrinsic motivation is a capacity that can fade away unless it's encouraged and developed. Learn how to help your children love learning and growing more than grades or privileges.

**Developing Emotional Intelligence**

For years, experts thought cognitive intelligence was the deciding factor in academic success and other achievement, but now greater importance is being given to emotional intelligence. Kids with an inner drive to work hard have the edge. ***Studies suggest students fueled by intrinsic motivation think more logically and apply their knowledge and skills more effectively.***

- **Focus on character.** Help your children acquire traits like patience, resilience, and persistence. Communicate your values by putting them into action.
- **Provide context.** Discuss what you believe and why. When your children understand the purpose behind cleaning their room and completing their homework, they'll be more likely to cooperate.
- **Set goals.** Age-appropriate challenges give kids something to strive for. Be specific and put their objectives in writing. Celebrate their progress and keep looking ahead.
- **Boost confidence.** Empower your kids with a strong sense of self-worth and optimism. ***Let them know that they are capable and worthy of amazing things.***

- **Strengthen relationships.** Feeling connected can inspire anyone to contribute to their family and

community. For some kids, social activities may increase their interest in household tasks and school subjects that they used to find boring.

- **Offer choices.** Show your sons and daughters that they have options. Deciding whether to spend their allowance money on comics or save up for a bicycle will introduce them to the advantages of delayed gratification.
- **Take risks.** ***Kids who feel secure are more likely to seize promising opportunities.*** Praise your kids for initiative and effort regardless of the immediate outcomes. That way they'll learn from setbacks instead of holding themselves back.

- **Stimulate curiosity.** Granted, teaching self-motivation is a big job, but kids make a great audience. They're already

inquisitive and adventurous. Guide their energy in a positive direction.

You have a powerful influence on your kids. Create a home environment that guides them towards satisfying their own expectations.

- **Start early.** When you think about it, it's impressive how determined kids are to start talking and walking. Your support can reinforce that inner fire and help them hang on when life becomes more complicated.

- **Limit rewards.** ***Studies show that external rewards can actually dampen our enthusiasm, even for tasks we like.*** Save them for special situations only.
- **Find a hobby.** On the other hand, devoting leisure time to enriching activities is a great teaching tool. Observe your child's talents and interests. Suggest outings and projects that will capitalise on their strengths.

- **Share feedback.** Open and ongoing communications build trust. Ask probing questions and listen closely to what your child thinks. Maybe they're pleased with how they're doing in school or maybe they need additional resources like tutoring so they can catch up and remain engaged.
- **Be a role model.** ***The more self-motivated you are, the more likely you will be to pass those qualities on to your kids.*** Whether you're returning to school to pick up a second degree or spending your weekends volunteering at an animal shelter, your children will pick up on your example.

Zahid Ameer

Editor

**Insperia eMagazine**

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# INSIDE

# 10 Chef-Approved Grilling Tricks to Take Your Barbecue to the Next Level

By **Sharon Sidwell**

There are plenty of ways to make this outdoor cooking season your best yet.


Summer is America’s season of pleasure—long weekends, refreshing swims, cold drinks—and the annual coronation of grilling as the seasonal king of cooking

methods. It doesn’t feel like summer has truly arrived until you’re outside and your backyard is filled with the heady smoke of a grill. While you might already know your way around a grill, there are plenty of ways to make this outdoor cooking season your best yet. We tapped lifelong griller Bill Briand, a three-time James Beard nominee and the executive chef at Playa at Sportsman Marina and Fisher’s at Orange Beach Marina, for his top grilling secrets.

## Grill and grill often

Whatever your favourite kind of grill is, Briand says, cook on it as much as you can while the weather holds out. The more comfortable you are with the grill, the more possibilities you can explore with this method of cooking. “I pretty much grill every night that I’m not cooking in the restaurant,” he says. For grilling novices (or experienced grillers looking for even more delicious and consistent results), Char-Broil TRU-Infrared cooking technology creates the closest thing to no-fail grilling. The magic lies just below the grates: a steel emitter plate retains the natural infrared heat of the flames and radiates that heat back to your food, yielding tastier, juicier meat, fish, vegetables, you name it.

## For big meat flavour, don’t be afraid of fat

Cooking on the grill lends itself well to cuts with a higher fat content. The high heat melts that nice marbling, resulting in tender,

flavorful meat. Briand’s favourites are ribs, rib-eye steaks, and pork butt. Be mindful when using fattier cuts as fat dripping on flames can cause sudden flare-ups and burn quickly. Char-Broil TRU-Infrared cooking technology features an emitter plate between the flames and your food, which helps prevent flare-ups and ensures your meat is perfectly cooked.

## Don’t forget about fish

While steaks, burgers, and chicken are always crowd-pleasers, seafood is also a fantastic—and healthy—choice for the grill. A Gulf Coast native, Briand is a longtime fisherman and loves grilling that day’s fresh catch. “Don’t be afraid to grill meaty fish like mahi-mahi and snapper,” he says. “Just oil the skin side and use the highest heat you can to keep it from sticking.” About 400°F will do the trick.

## Brine it

A salt-forward marinating technique that is often forgotten after Thanksgiving, brining is Briand’s favourite way to prep chicken for the grill—it turns out juicy, flavorful meat every time. Briand advises planning ahead, as you’ll need to brine overnight for optimum flavour. Start with a 1/2-gallon of liquid (Briand likes to use a blend of water and, or water and tea) and add ½ cup each of sugar and salt. Bring the mixture to a boil to dissolve, remove from

heat, and add handfuls of fresh herbs like bay leaves, thyme, or rosemary. When the brine is cool, submerge the meat and refrigerate overnight.

**Juice up your wood chips**

Wood chips are an excellent way to add a subtle smokey flavour to whatever you're grilling. "To give your smoke a pleasant citrus flavour, soak your chips in orange juice," says Briand. He suggests soaking them for two hours before using them to make sure they don't burn up on the grill. When you're ready to grill, put the chips in a smoker box and place over direct heat to get them smoking, then transfer to a cooler side of the grill before you add your ingredients. Char-Broil offers a variety of wood chips, from mesquite and whiskey wood to Tabasco and cherry.

**Prep everything first**

Briand likes to prepare his meat, vegetables, and any accompanying sauces in the kitchen before he even lights the grill. He

recommends bringing the entire setup outside whenever you're ready to start cooking. That way you can chat with friends and family on the deck or patio and concentrate on the food without having to pop in and out of the kitchen.

**Split the space**

One of the most convenient things about grilling is that you can cook meat and vegetables in the same space, with minimal cleanup after dinner. When cooking over a single flame (and therefore just one major heat level), Briand puts vegetables on one side and meat on the other to make keeping track of cooking times easier. The Char-Broil Commercial Series TRU-Infrared Double Header Gas Grill further simplifies the process with two separate cooking zones along with four main burners, including a stovetop and griddle side burner. Make sure you've stocked up on the right tools, from tongs to spatulas, to manage the flow.

**Be patient**

A good sear is half the pleasure in grilled food. If you want your meat to have a proper crust, be sure not to turn your meat too soon. Heat your TRU-Infrared Grill to medium or medium-high (400°F), then use this handy guide to determine how many minutes per side your protein needs. Once you've achieved that elusive sear, don't forget to test doneness—it's all about the internal temperature. "I always use a grilling thermometer to check whether my meat is done," Briand says.

**Enjoy the moment**

Grilling season is short, so make the most of it. Part of the pleasure of cooking outside is taking in your natural surroundings, inhaling the tantalising aroma of what you're cooking, and enjoying the party itself, says Briand. After all, it's summertime, and the entertainment should be easy.

## Clean smart

Once the barbecue is over and the grill cools down, scrape the grates with a brush like the Char-Broil Cool-Clean brush. The nylon bristles make it easier to use than metal or wire brushes. Then take a rag and wipe down the grates with a thin coat of cooking oil to keep rust at bay, which can be especially challenging if, like Briand, you live somewhere humid. Briand recommends wiping down your grill with lard because “it sticks to the grates really well”—there’s no better advice from a Southern chef.

*This article is sponsored by Char-Broil.*

# Birds Migrate Along Ancient Routes: How Scientists Are Tracking Their Amazing Journeys

By **Tom Langen**

Satellite telemetry, tiny geolocation tags and passive acoustic recording are providing new insights into bird migration and vital data for conservation.

*Migrating waterbirds over South Dakota's Huron Wetland Management District on North America's Central Flyway. Sandra Uecker, USFWS/Flickr*

Although it still feels like beach weather across much of North America, billions of birds have started taking wing for one of nature's great spectacles: fall migration. Birds fly south from the northern U.S. and Canada to wintering grounds in the southern U.S., Caribbean and Latin America, sometimes covering thousands of miles. Other birds leave temperate Eurasia for Africa, tropical Asia or Australia.

Using observation records and data collected through bird banding, 20th-century ornithologists roughly mapped general migration routes and timing for most migratory species. Later, using radar at airports and weather stations, they discovered how weather and other factors affect when birds migrate and how high they fly.

Today, technological advances are providing new insights into bird migration and showing that it is more complex and wonderful than

scientists ever imagined. These new and constantly improving technologies are key aids for protecting migratory birds in the face of habitat loss and other threats.

**Birding across borders**

The power of the internet has greatly aided migratory bird research. Using the popular eBird network, birders all over the world can upload sightings to a central database, creating a real-time record of the ebb and flow of migration. Ornithologists have also learned to use NEXRAD, a national network of Doppler weather radars, to visualise birds migrating down the North American continent.

Now, scientists are setting up a global network of receiver stations called the Motus Network, which currently has 1,500 receivers in 31 countries. Each receiver constantly records the presence of any birds or other animals within a nine-mile (15-kilometer) radius that scientists have fitted with small,

lightweight radio transmitters, and shares the data online. The network will become increasingly useful for understanding bird migration as more receiver stations become active along migration tracks.

**Tracking individual birds via satellite**

Three new technologies are rapidly expanding what we know about bird migration. The first is satellite telemetry of bird movement. Researchers fit birds with small solar-powered transmitters, which send data on the birds' locations to a satellite and then on to a scientist's office computer. The scientist can learn where a bird is, the route it took to get there and how fast it travels.

For example, the bar-tailed godwit, a pigeon-sized shorebird, breeds in Alaska and then migrates to New Zealand. Satellite transmitters show that godwits often fly nonstop from Alaska to New Zealand. Recently, a godwit set the record for the

longest nonstop flight by a land bird: 8,100 miles (13,000 kilometres) in 10 days, from Alaska to Australia.

Satellite telemetry studies show how much individual birds, even those from the same breeding location, vary in their migratory behaviour. Individual differences in migratory behaviour are probably due to differences in physical condition, learning, experience and personal preferences.

Another shorebird, the whimbrel, also makes a phenomenally long journey over the ocean. Satellite telemetry has shown that some whimbrels travel from northwest Canada, across the North American continent to Canada's east coast, then set off over the Atlantic Ocean on a 3,400-mile (5,400-kilometre), six-day nonstop flight to the coast of Brazil. In total, they may travel 6,800 miles (11,000 kilometres).

Sadly, hunters kill some of these birds when they land to rest on islands in the Lesser

Antilles. The unfortunate fate of two satellite-tracked whimbrels has catalysed a campaign to tighten regulations on shorebird hunting in the Caribbean.

**Geotagging small birds**

Many birds are too small to carry a satellite transmitter. Given the energetic effort required for migration, a device must weigh less than 5% of a bird's body weight, and many migratory songbirds weigh under 0.7 ounces (20 grams).

An ingenious solution for small birds is a geolocator tag, or geologger – a tiny device that simply records time, location and presence or absence of sunlight. Scientists know the timing of sunrise and sunset on a given date, so they can calculate a bird's location on that date to within about 125 miles (200 kilometres).

Birds carrying geologgers must be recaptured to download the data. That means the bird must survive a migration

round trip and return to the same place where it was first captured and tagged. Amazingly, many geologger-tagged small birds do.

Geologgers have shown that Blackpoll warblers – small songbirds that breed in the boreal forests of North America – fly long distances over the Atlantic in fall, heading to the Amazon basin. Birds breeding in eastern North America head out over the Atlantic in maritime Canada or the northeastern U.S. and make a 60-hour, nonstop, 1,500-mile (2,500-kilometre) flight to the Greater Antilles. There they rest and recuperate, then continue across the Caribbean to South America.

Blackpolls breeding in Alaska fly across the North American continent before leaving shore on the Atlantic coast and flying to South America. In total, they journey 6,600 miles (10,700 kilometres) over 60 days.

Even more amazing, geologgers show that another small songbird, the northern wheatear, migrates from North America to sub-Saharan Africa. Wheaters that breed in Alaska fly 9,100 miles (14,600 kilometres) across Asia to East Africa, taking three months to do so. Those breeding in eastern Canada journey 4,600 miles (7,400 kilometres) across the Atlantic to Europe and then on to West Africa – including a 2,100-mile (3,400-kilometre), four-day nonstop overwater flight.

**Recording birds' night migration calls**

Two hours after sunset in fall, I like to sit outside and listen to birds migrating overhead. Most birds migrate at night, and many give a species-specific "chit," "zeep" or other call-note while in flight. The calls may serve to keep migrating flocks together, including different species heading to the same destination.

Ornithologists are using automated passive acoustic recording to study these nocturnal calls and identify the species or group of related species that make each sound. The technology is a microphone directed at the sky, connected to a computer that continuously records the sound stream and is aided by sound recognition software. Sometimes it reveals migrants overhead that are rarely seen on the ground.

Nick Kachala, an honours student in my lab, set up recording units on three university properties in the fall of 2021. One of the most common migrants recorded was the gray-cheeked thrush, a shy bird of the northern boreal forest that is rarely seen in the northeast U.S. during fall migration. He also detected the dickcissel, a grassland bird that I have never seen in our area.

Many bird watchers are now building do-it-yourself backyard recording units to identify the birds flying over their homes during migration.

## Conserving migratory birds

Radar monitoring indicates that the number of North American migratory birds declined by 14% between 2007 and 2017. There probably are multiple causes, but habitat loss is likely the principal culprit.

Satellite telemetry and geologgers show that there are special stopover sites along migration routes where migrants rest and refuel, such as the Texas Gulf Coast, the Florida Panhandle and Mexico's Yucatan Peninsula. Conservation experts widely agree that to protect migratory birds, it is critical to conserve these sites.

Effective conservation measures require knowing where and how birds migrate, and what dangers they face during migration. Ornithologists, using these new technologies, are learning things that will help to stop and reverse the global decline in migratory birds.

*Tom Langen is a professor of biology at Clarkson University.*

# We’re in a Self-Checkout Stalemate

Despite complaints from customers and stores, self-checkout is here to stay.

By **Brianna Wellen**


Self-checkout at grocery stores is becoming polarising. Some customers love it for the sense of control and absence of small talk with the person bagging your groceries. Others hate being tasked with the labour of checking out their own haul, not to mention the frustrating tech errors, like an “unexpected item in the bagging area” that is

not there. The stores themselves now seem just as torn, turning their backs on self-checkout apps and other technologies originally touted as the future of grocery shopping. It seems we've found ourselves in a conundrum where we just can't live with or without self-checkout.

## Why Wegmans and Amazon Fresh are stopping self-checkout

Both supermarket chain Wegmans and Amazon Fresh stores had previously implemented some form of a "just walk out" self-checkout system. In the case of Wegmans, you skipped the checkout line by using an app to scan your groceries as you go. Amazon Fresh implemented decidedly creepier technology that tracks which items you pick up and put down, charging you for whatever is in your cart when you leave. However, both stores are now suspending the use of these technologies.

According to *The New York Times*, Wegmans attributed the decision simply to “the losses” being experienced. Similarly, Insider reports that Amazon Fresh experienced “disappointing sales” with this just-walk-out model, especially considering how much more it costs to build markets with this technology compared to a typical grocery store.

But there’s also speculation that these methods make it easier to shoplift, which contributes to losses across the board. Neil Saunders, managing director and retail analyst at GlobalData Retail, tells *The New York Times* that this theory could be especially true at this moment because in-store theft typically rises when the cost of living goes up. But neither Wegmans nor Amazon Fresh has explicitly commented that this is the reason behind the decision, and without that confirmation or any concrete

numbers it feels like yet another instance of punishing shoppers for crimes they haven't committed.

**Why self-checkout grocery shopping is here to stay**

Despite the fact that self-checkout systems can cause issues on both the retailer and shopper end of the transaction, it's likely that the method is not only here to stay, but will become even more ubiquitous. According to the *Wall Street Journal*, self-checkout represented 30% of all grocery transactions in 2021 (up from 18% in 2018), and self-checkout machines are now at 96% of the 38,000 retail stores surveyed by The Food Industry Association.

The labour shortage is a driving force behind the expansion of these machines. A traditional grocery shopping setup requires

one cashier (and possibly a bagger) per every checkout lane, while only one employee is needed to oversee as many as 10 self-checkout kiosks. Even as stores like Wegmans and Amazon Fresh rethink their more advanced technologies, the fallback doesn’t involve adding more cashiers to check people out, but rather adding more supervised self-checkout lanes.

Even with all the possible errors a customer might encounter at a self-checkout kiosk, with fewer cashiers to staff traditional checkout lanes it often becomes the most efficient method. Instead of waiting in a snaking line that bottlenecks at one person scanning everyone’s groceries, you can stand in an always-moving line that cycles through multiple checkout points.

If major supermarket chains feel like their high-tech self-checkout solutions haven’t

been worth the financial investment, the focus should be on creating a more desirable working environment for their employees and using those incentives to lure more workers in turn. Otherwise, more time and money should be invested in the existing self-checkout technology to avoid the errors that irk customers most. As for customers, it’s time to perfect your bagging technique—if your bread gets smooshed, you have no one to blame but yourself.

# Explore India's Rich Heritage And Diversity At These Sites

## Ancient rock art in cave clusters to unique parks, forts, and even a nursery - these places showcase the amazing diversity and heritage of India. And they have all received recognition from UNESCO for the same.

By **Outlook** Staff

*Ruins with intricate carvings at the historical Nagina Masjid in the Champaner-Pavagadh Archaeological Park in Gujarat, Photo Credit: Shutterstock*

A great way to explore a place is through the lens of culture and heritage and local distinctiveness. Cultural heritage stimulates a respect and understanding of other

cultures and, as a consequence, promotes peace and understanding. India is one of the most diverse places in terms of cultural heritage with different heritage routes offering unique experiences based on UNESCO recognised heritage. And, as UNWTO says, culture and cultural heritage can help to achieve inclusive and sustainable development. Cities and regions can be regenerated through cultural heritage. Responsible travel ethics can also promote adaptive re-use of heritage buildings. Heritage-based tourism can also spur investment in culture and the creative industries that are community-centred. Here's a look at some places in India that showcase the diversity of its cultural assets.

**A Nursery**

If you are in Delhi, do check out the Sunder Nursery. It has won the inaugural UNESCO Special Recognition for Sustainable Development in 2020. The Sunder Nursery got the award for its transformative

management of the historic premises adjoining Delhi's popular Humayun's Tomb. The 90-acre heritage, ecological and nursery zone, which was opened to the public in 2018, was renovated over a decade by the Aga Khan Trust for Culture (AKTC), in partnership with the Central Public Works Department (CPWD) and the Archaeological Survey of India (ASI). According to the jury, they chose Sunder Nursery because of the "transformative impact in turning a barren site into an urban oasis in the heart of New Delhi". The jury also appreciated the fact that the Sunder Nursery paid "equal attention to ecological restoration, thus underscoring the message that heritage conservation is beyond monuments and is only truly sustainable when essential linkages between nature and culture are profoundly understood and nurtured."The Sunder Nursery also received the Award For Excellence in this year's UNESCO Asia-Pacific Awards for Cultural Heritage Conservation.

## A Railway Station

Having borne the weight of great names, Mumbai’s Chhatrapati Shivaji Terminus, formerly known as Victoria Terminus is a World Heritage Site under UNESCO. With its imposing stone dome, turrets, pointed arches, and eccentric ground plan, VT was chosen as an example of late 19th century railway architecture in the British Commonwealth. The building, designed by the British architect F.W. Stevens took ten years in the making and was finally completed in 1888. The terminal was built over a period of 10 years, starting in 1878, according to a High Victorian Gothic design based on late mediaeval Italian models. Its remarkable stone dome, turrets, pointed arches and eccentric ground plan are close to traditional Indian palace architecture. It is an outstanding example of the meeting of

two cultures, as British architects worked with Indian craftsmen to include Indian architectural tradition and idioms thus forging a new style unique to Bombay/Mumbai.

**An Example Of Community Living**

The old city of Ahmedabad has several housing clusters (called pol) which comprise families of a particular group, linked by caste, profession, or religion. And the pol has been one of the key reasons that earned Ahmedabad (or Ahmadabad as Unesco spelled it) a place on the Unesco World Heritage List in 2017. It was the first Indian city (the second being Jaipur) to be thus honoured. The couple-of-centuries-old neighbourhoods that dot the earlier parts of the city are an example of community living. Architectural diversity is a key attraction of Ahmedabad. And it is fortunate that

Ahmedabad has seen some of its centuries-old havelis (palatial homesteads) saved from demolition, thanks to several initiatives. For instance, the Diwanji ni Haveli, a dilapidated over 250-year-old residential house with ornate architecture, was restored and turned into an office of the City Heritage Centre (CHC) from where a heritage preservation and restoration enterprise is run. The walled city, with more than 20 monuments protected by the Archaeological Survey of India (ASI) and other attractions, including several key museums, preserves within itself a rich architectural heritage and cultural legacy, which is an integral part of the local lifestyle. “The walled city of Ahmedabad, founded by Sultan Ahmad Shah in the 15th century, on the eastern bank of the Sabarmati river, presents a rich architectural heritage from the sultanate period, notably the Bhadra citadel, the walls

and gates of the Fort city and numerous mosques and tombs as well as important Hindu and Jain temples of later periods," said Unesco in its introduction to the city.

**Churches and Convents**

Apart from visiting its beaches, no trip to Goa is complete without visiting the Church of Bom Jesus in Old Goa where the mortal remains of St Francis Xavier lies. But did you know that the casket (encasing the glass box with the body), built by Goan craftsmen in the mid-17th century, is considered a rare work of art, blending Indian and Italian styles? Old Goa or Velha Goa, the former capital of the Portuguese possessions in India, with its churches and convents, have been put under the umbrella of UNESCO's world heritage sites. So instead of rushing through them on a whirlwind tour, do spend time exploring

them, learning about their architectural style, the artefacts within, and their history.

**An Archaeological Park**

Around the year, hundreds of Hindu and Jain pilgrims visit Pavagadh, around 55km from Vadodara, the third largest city in Gujarat. But only a handful know that they are entering a UNESCO World Heritage Site. Known as the Champaner-Pavagadh Archaeological Park, the area won the honour in 2004. The archaeological park is spread across the twin towns of Champaner and Pavagadh, located about five km apart from each other. One of the key features that earned the region its World Heritage Site status is the perfect blend of Hindu-Moslem architecture seen in many of the buildings. The Great Mosque (Jami Masjid) is said to have served as a model for later mosque architecture in India. Both towns contain several Jain temples,

mostly belonging to the Digambara sect. Some of the other attractions include prehistoric (chalcolithic) sites, a hill fortress of an early Hindu capital, ruins of fortifications, palaces, religious buildings, residential precincts, agricultural structures and water installations, from the 8th to 14th centuries.

**Ancient Rock Shelters**

Bhimbetka Caves, also known as the Bhimbetka Rock Shelters, is an archaeological site located in the Raisen District of Madhya Pradesh. The rocks are believed to have been a witness to the Palaeolithic and Mesolithic periods. Spanning across 10 km, there are close to 750 rock shelters and seven hills in the area. These caves have now been declared a UNESCO world heritage site, owing to their historical significance. The rock shelters are

a canvas for some of the oldest paintings in India and the rock caves are believed to be among the oldest petroglyphs in the world. Some of the rock paintings in the area are very similar to aboriginal rock art found in Australia and the Palaeolithic Lascaux cave paintings discovered in France. Despite there being more than 700 rock shelters, only 12 to 15 are open and accessible to visitors. Most of the paintings are done in red and white on the cave walls. A multitude of themes were covered in this form of rock art and it depicted scenes like singing, dancing, hunting and other common activities of the people staying there. This also adds strength to the argument that the caves used to be home for hundreds of people sometime during 300 BC. The oldest of the cave paintings in Bhimbetka is believed to be about 12,000 years ago. The paintings have been divided into various periods like Upper

Palaeolithic, Mesolithic, Chalcolithic, Early History and Mediaeval history. They are present in 500 caves out of the total of 750. However, experts are of the opinion that there may have been many more which got eroded with time.

**A Modern Architectural Trail**

In 2016, UNESCO inscribed a selection of works by world renowned architect Charles-Édouard Jeanneret-Gris, better known as Le Corbusier (1887–1965) as ‘a testimonial to the invention of a new architectural language that made a break with the past’. Chosen from the work of Le Corbusier, the 17 sites comprising this transnational serial property are spread over seven countries and are a testimonial to the invention of a new architectural language that made a break with the past, said UNESCO. They were built over a period of a

half-century, in the course of what Le Corbusier described as “patient research”. The Le Corbusier works are spread across several countries, but in India, it is The Complexe du Capitole in Chandigarh that has made it to the list as it reflects the solutions that the Modern Movement sought to apply during the 20th century to the challenges of inventing new architectural techniques to respond to the needs of society. So next time you are in the city, do check out this over 100-acre government compound which contains, among other things, the Palace of Assembly or Legislative Assembly, Secretariat, High Court, Open Hand Monument, Geometric Hill and Tower of Shadows.

# Can You Be Healed By a Touch?

## Here's what's behind the popular but controversial therapies, such as reiki, known as "energy medicine."

By **Andrew Weil**

Few therapies are more controversial than the ones known collectively as "energy medicine."

The term became popular in the late 1980s to describe medical interventions thought to

influence energy fields (also called biofields) surrounding living organisms and the flow of vital energy through the body’s cells, tissues, and organs.

These fields and flows can be impaired, practitioners believe, by physical or mental trauma.Energy medicine aims to rebalance them in order to restore physical and mental health.Some describe the process as an exchange of energy between the healer and the patient.

If this sounds far fetched, keep in mind that measurable forms of energy have a long-standing, respected position in medicine. Radiation and sound waves, for example, can be used to destroy tumours or break apart kidney stones.

The controversial types of energy medicine are those that deal with unmeasurable—and, some argue, nonexistent—forms of energy.

These include qi in traditional Chinese medicine, prana in the traditional medical system of India (Ayurveda), and “subtle energy” in the West. Two forms that are popular today:

**Healing Touch**

Founded in 1989 by an American nurse, Healing Touch typically involves a 10- to 40-minute session in which a practitioner passes his or her hands over a patient’s body to sense imbalances. Patients remain fully clothed, either seated or lying down, and the practitioner uses gentle touch or near-body sweeping motions to reestablish biofield balance. Some studies have suggested that Healing Touch can reduce pain from spinal cord injuries and other types of chronic pain. To find a certified practitioner, visit the Healing Touch Professional Association’s website.

### Reiki

A modality developed in Japan in 1922, Reiki is similar to Healing Touch in that the patient is clothed and the practitioner's hands are placed lightly on or above the body. Sessions are longer, up to 90 minutes, and Reiki is regarded as both a spiritual and an energetic form of healing. A few studies indicate potential usefulness in alleviating pain and depression. To find a trained practitioner, visit the website of the International Association of Reiki Professionals.

### My take on energy medicine

The fact that conventional medicine doesn't recognize qi, prana, or other subtle energies does not mean these energy medicine practices don't work. In fact, whether by manipulating energy fields and flow or by using a patient's beliefs (the placebo effect),

there’s evidence that they can offer significant benefits without serious side effects.

I firmly believe that the greater the potential of a treatment to cause harm, the stricter the standard should be for evidence that it works.Because energy medicine practices have an excellent record of safety,

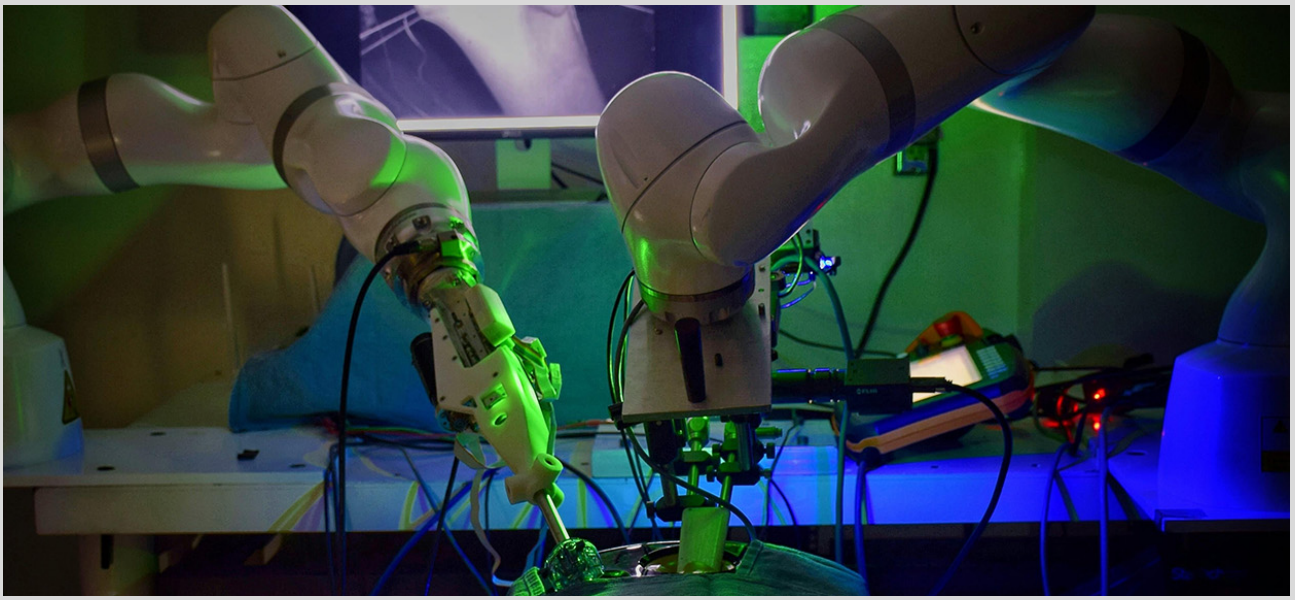
I see no harm in using them to address non-life-threatening conditions

such as postoperative or chronic pain. For more serious conditions, they may be able to serve as adjunctive treatments to conventional therapies.

# Handing the surgeon’s scalpel to a robot

## After decades of merely assisting doctors, are sophisticated machines ready to take charge?

By **James Gaines**



In 2004, the United States’ Defence Advanced Research Projects Agency (DARPA) dangled a $1 million prize for any group that could design an autonomous car that could drive itself through 142 miles of rough terrain from Barstow, California, to Primm, Nevada. Thirteen years later, the

Department of Defence announced another award — not for a robot car this time, but for autonomous, robotic doctors.

Robots have been found in the operating suite since the 1980s for things like holding a patient's limbs in place, and later for laparoscopic surgery, in which surgeons can use remote-controlled robot arms to operate on the human body through tiny holes instead of huge cuts. But for the most part these robots have been, in essence, just very fancy versions of the scalpels and forceps surgeons have been using for centuries — incredibly sophisticated, granted, and capable of operating with incredible precision, but still tools in the surgeon's hands.

Despite many challenges, that is changing. Today, five years after that award announcement, engineers are taking steps

toward building independent machines that not only can cut or suture, but also plan those cuts, improvise and adapt. Researchers are improving the machines' ability to navigate the complexities of the human body and coordinate with human doctors. But the truly autonomous robotic surgeon that the military may envision — just like truly driverless cars — may still be a long way off. And their biggest challenge may not be technological, but convincing people it's OK to use them.

**Navigating unpredictability**

Like drivers, surgeons must learn to navigate their specific environments, something that sounds easy in principle but is endlessly complicated in the real world. Real-life roads have traffic, construction equipment, pedestrians — all things that don't

necessarily show up on Google Maps and which the car must learn to avoid.

Similarly, while one human body is generally like another, children's movies are right: We're all special on the inside. The precise size and shape of organs, the presence of scar tissue, and the placement of nerves or blood vessels often differ from person to person.

"There's so much variation in the individual patients," says Barbara Goff, a gynecologic oncologist and surgeon-in-chief at the University of Washington Medical Centre in Seattle. "I think that that could be challenging." She's been using laparoscopic surgical robots — the kind that don't move on their own but do translate the surgeon's movements — for more than a decade.

The fact that bodies move poses a further complexity. A few robots already display some amount of autonomy, with one of the

classic examples being a device with the (maybe-a-bit-on-the-nose) name ROBODOC, which can be used in hip surgery to shave down bone around the hip socket. But bone's relatively easy to work with and, once locked into place, doesn't move around much. "Bones don't bend," says Aleks Attanasio, a research specialist now at Konica Minolta who wrote about robots in surgery for the 2021 *Annual Review of Control, Robotics, and Autonomous Systems*. "And if they do, there's a bigger problem."

Unfortunately, the rest of the body isn't as easy to lock in place. Muscles contract, stomachs gurgle, brains jiggle, and lungs expand and contract, for instance — even before a surgeon gets in there and starts moving things around themselves. And while a human surgeon can obviously see and feel what they're doing, how could a robot know if

its scalpel is in the right place or if tissues have shifted?

*The da Vinci surgical robot, shown here on a US Navy hospital ship, is one of the most widely used devices to assist doctors in laparoscopic surgery. The procedure — in which tools are inserted through tiny holes in the abdomen instead of cutting a long incision — allows patients to recover more quickly.*

CREDIT: KELSEY L. ADAMS, US NAVY / FLICKR

One of the most promising options for such dynamic situations couples the use of cameras and sophisticated tracking

software. In early 2022, for example, researchers at Johns Hopkins University used a device called the Smart Tissue Autonomous Robot (STAR for short) to sew two ends of severed intestine back together in an anaesthetised pig — a potentially very jiggly task — thanks to this visual system.

A human operator tags the ends of the intestine with drops of fluorescent glue, creating markers the robot can track (a bit like an actor wearing a motion-capture suit in a Hollywood movie). At the same time, a camera system creates a 3-D model of the tissue using a grid of light points projected onto the area. Together, these technologies allow the robot to see what is in front of it.

“What’s really special about our vision system is that it allows us to not only reconstruct what that tissue looks like, but it also does so fast enough that you can do it

in real time," says STAR system codesigner Justin Opfermann, an engineering PhD student at Hopkins. "If something does move during the surgery, you can detect and follow it."

The robot can then use this visual information to predict the best course of action, presenting the human operator with different plans to choose from or checking in with them in between sutures. In tests, STAR worked well on its own — though not perfectly. In total, 83 percent of the sutures could be done autonomously, but the human still had to step in the other 17 percent of the time to correct things.

"The 83 percent can definitely be overcome," says Opfermann. Most of the problem was that the robot had a little trouble finding the right angle at certain corners and needed a human to nudge it into the right spot, he

says. Newer, yet-to-be-published trials now have success rates in the high 90s. In the future, the human may only need to approve the plan, then watch it go, no intervention needed.

**Passing the safety test**

For now, though, there still needs to be someone in the driver's seat, so to speak. And it might be that way for a while for many different autonomous robots: While we could theoretically hand over complete decision-making to the robot, this does raise a question — one that has also plagued driverless cars.

"What happens if some of these activities go wrong?" says Attanasio. "What if the car has an accident?"

The general view, for now, is that keeping the humans ultimately in control is best — at

least in a supervisory role, reviewing and signing off on procedures and standing by in case of emergency.

Even so, proving to hospitals and regulators that autonomous robots are both safe and effective may be the single biggest roadblock to truly human-free robots entering the surgical suite. Experts have a few takes on how to get around this.

For instance, designers will likely need to be able to explain to regulators exactly how the robots think and decide what to do next, says Attanasio, especially if they progress to the point where they’re not just assisting a human surgeon but arguably practising medicine themselves. That explanation may be easier said than done, though, since current artificial intelligence systems may leave observers few hints of how they make decisions. As a result, engineers may want to

design with “explainability” in mind from the beginning.

Pietro Valdastri, a biomedical engineer at the University of Leeds in England and one of Attanasio’s coauthors, thinks it’s possible that no manufacturer will be able to easily solve the regulatory question, though he does have a work-around. “The solution here is to make a system that even if it’s autonomous, it’s inherently safe.” This means the next generation of surgical robots may not resemble roadsters so much as bumper cars.

Valdastri is working on what are known as soft robots, particularly for colonoscopies. Traditionally, a colonoscopy requires snaking a flexible tube with a camera — an endoscope — through the intestine to look for early signs of colon cancer. The procedure is recommended for anyone over

the age of 45 — but it can take a long time and a lot of training for an operator to become proficient with the endoscope. With few properly trained operators to go around, waitlists have ballooned.

But using a smart robot that can steer itself would make the job much easier — like driving a car in a video game, Valdastri says. The doctor could then focus on the matter at hand: spotting early signs of cancer. And in this case, the robot, created from soft materials, would be inherently safer than more rigid devices. It may even reduce the need for anaesthesia or sedation, says Valdastri, since it could more easily avoid pushing against the intestinal walls. And with no way for the robot to cut or zap anything on its own, it may be easier for regulators to accept.

As the technology develops, Opfermann suggests, autonomous robots may start out getting approval only for simpler tasks, such as holding a camera. As more and more of these basic jobs get approved, the tasks may build up into an autonomous system. In cars, we first got cruise control, he says, but now there's brake assist, lane assist, even assisted parking — all of which build towards something driverless.

"I think this will be kind of similar," says Opfermann, "where we see small, autonomous tasks that eventually get chained together into a full system."

***James Gaines*** *is a researcher for* Knowable Magazine *and a freelance science journalist living in Seattle. He is autonomous, but struggles to explain how or why.*

# The Rosetta Stone: The real ancient codebreakers

## Egyptian hieroglyphs were fully unlocked 200 years ago, when the Rosetta Stone was deciphered. Yet long before that, Arabic scholars had made their own discoveries with these ancient scripts

By **Daisy Dunn**

Jean-François Champollion had been struggling over the hieroglyphs on the Rosetta Stone for years when, one September afternoon in 1822, he believed he

had finally cracked it. In his intense excitement, the 31-year-old Frenchman gathered up his notes, hurried to find his brother, and promptly fainted.

The chance discovery of the monument in the Nile Delta at Rosetta, modern Rashid, some 23 years earlier had roused the interest of scholars globally. One of Napoleon's lieutenants, a military engineer named Pierre-François-Xavier Bouchard, was directing the demolition and reconstruction of the city's fort in July 1799 when the black object was spotted beneath the debris. To his credit, Bouchard realised at once that it was something important, and had it cleaned before taking it to the respected Institut d'Égypte in Cairo for closer examination.

Strikingly, the heavy slab featured three inscriptions, each of which was very different to look at. One was written in classical Greek;

another in Egyptian hieroglyphs; and the third in what was assumed to be Syriac, but later identified as Demotic (a later Egyptian script used for day-to-day correspondence). As Bouchard perceived, assuming the inscriptions all said the same thing, knowledge of Greek could be used to decode the other two texts, which had until now eluded total decipherment.

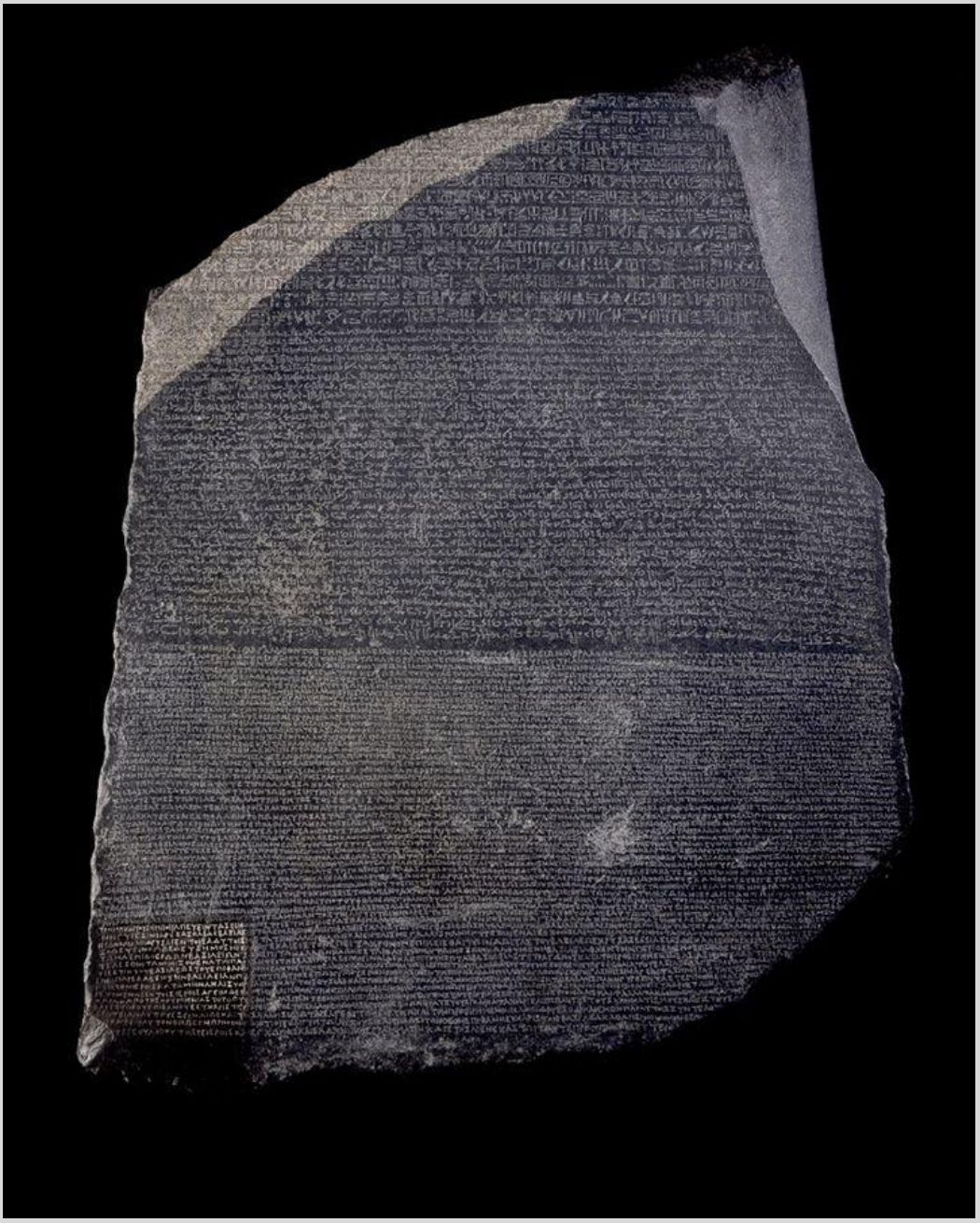
This prospect was immensely exciting. The stone was therefore shipped to the Society of Antiquaries in London where copies were made and disseminated to cities and universities across the world. The original was installed at the British Museum at the bequest of King George III in 1802.

**Champollion had solved only part of the puzzle when he leapt from his chair claiming to have 'Got it!'**

The race was then on to translate the Greek and use it to unravel the secrets of the other two languages. The legible text confirmed that the three inscriptions were indeed identical in content and related to a decree passed by a council of priests in Memphis regarding the cult of Ptolemy V in the 2nd Century BC. As the timeframe between the excavation of the stone in 1799 and Champollion's eureka moment in 1822 suggests, however, the code-cracking challenge proved harder than anticipated. What was more, contrary to his belief, Champollion had solved only part of the puzzle when he leapt from his chair claiming to have "Got it!"

In October, an exhibition will open at the British Museum in London to mark the bicentenary of Champollion's breakthrough, which anticipated his complete

decipherment of hieroglyphs. As the accompanying catalogue explains, the Figeac-born scholar "was certainly the first to grasp the structural logic of the ancient



*Hieroglyphic, Demotic and Ancient Greek inscriptions are carved into the Rosetta Stone*

Egyptian language in its varied forms", and consequently enjoyed an enduring reputation as the man who won the intellectual race. But was Champollion really the trailblazer he was believed to be?

Almost a millennium before the Rosetta Stone was even discovered, Arabic scholars had begun to grapple with the hieroglyphs they found on Egyptian monuments and tomb paintings. The highly pictorial method of writing was first developed about 3250 BC and known in Egyptian as "divine words" and in Greek as "sacred carving" or "hieroglyph". Although it had ceased to be used by the 5th Century AD, these mediaeval scholars believed that the script could still be deciphered, and the secrets of the inscriptions revealed.

**Not only was Ibn Wahshiyya able to understand some of the hieroglyphs, but he**

**was apparently working with the concept that a known script could be used to decipher an as-yet unknown one**

In the 9th Century, an Iraqi alchemist named Abu Bakr Ahmad Ibn Wahshiyya turned his hand to translating hieroglyphs in the hope of rediscovering lost scientific knowledge. This belief, says Dr Okasha El Daly, senior honorary research fellow at the Institute of Archaeology at University College London and head of acquisitions at Qatar University Press, "wasn't that far-fetched, for some temple walls do have scientific texts relating to alchemic processes on them".

Ibn Al-Nadim, the son of a 10th-Century Baghdadi bookseller, recorded seeing Ibn Wahshiyya's notebooks full of symbols. Not only was Ibn Wahshiyya able to understand some of the hieroglyphs, but, as Al-Nadim pointed out, he was apparently working with

the concept – later employed by Champollion – that a known script could be used to decipher an as-yet unknown one.

*Ibn Wahshiyya's 985 AD translation of the Ancient Egyptian hieroglyph alphabet*

This method was almost simultaneously taken up by Champollion's chief rival Thomas Young. Described by his modern biographer as the "The Last Man Who Knew Everything", the English polymath concentrated on the Demotic script on the stone, realising that this could provide the key to understanding

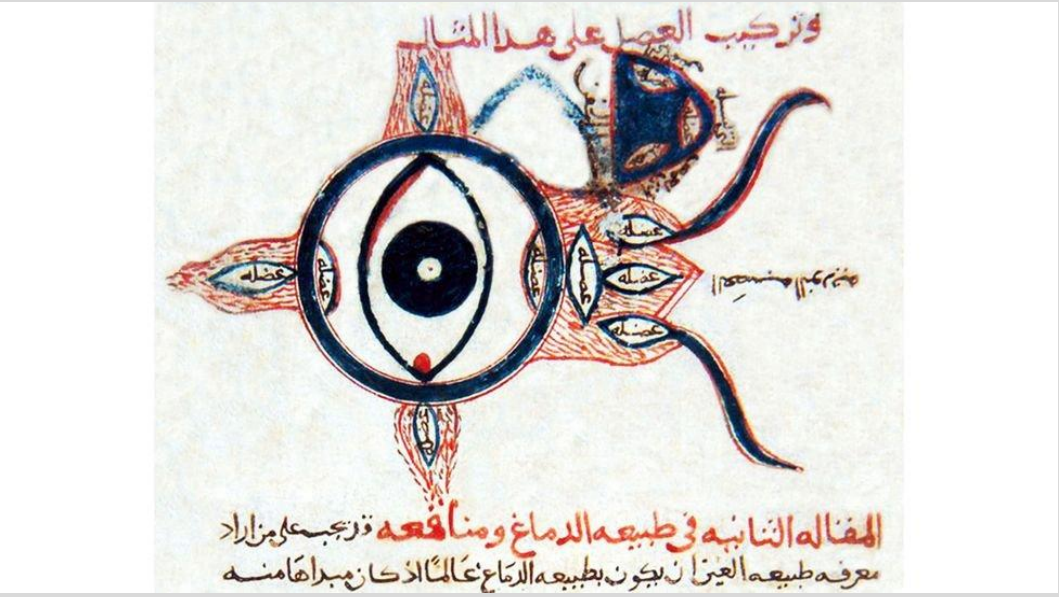
the hieroglyphs. In a book of 1814, Young revealed some of his workings across the three inscriptions of the Rosetta Stone. His eventual success in deciphering Demotic proved invaluable to Champollion, who proceeded to beat him in the contest to decode the corresponding hieroglyphs.

**Accumulated wisdom**

As Dr El Daly tells BBC Culture, "Scientific progress is an accumulated thing. Champollion did not work from nothing. He started from studying earlier contributions. He also knew Arabic." It is highly likely, indeed, that the linguist accessed manuscripts containing some of the work by Arabic writers who had attempted to decipher hieroglyphs in the intervening millennium.

An earlier Western scholar, Athanasius Kircher of Germany, had certainly done

precisely this and consulted Arabic writings, usually in translation, while carrying out research for his own book on deciphering Egyptian hieroglyphs. More than 40 Arabic sources are mentioned in Kircher's sprawling Oedipus Aegyptiacusof the mid-17th Century. His knowledge of the work of Ibn Wahshiyah is not in doubt. Unfortunately, Champollion failed to cite his sources in the same way, meaning that the contribution of earlier scholars to his eventual success has been difficult to assess in any depth.




*Hunayn ibn Ishaq translated many classical Greek texts, including medical and scientific treatises, into Arabic and Syriac*

It was not unusual for the transmission of knowledge to be clouded in this way as it travelled through the hands of scribes and scholars in the East. Dr Violet Moller, author of The Map of Knowledge, explains that Arabic scholars who were instrumental in carrying ideas from antiquity into the Renaissance have all too often been overlooked or even written out of history. "It's impossible to know what the individual motives behind this were. When the medical books of the Greek author Galen, for example, were translated from Greek into Arabic, revised and significantly amended by a man named Hunayn Ibn Ishaq, some Latin scholars presented the work as purely Greek. There was no mention of the Arabic scholar who was the conduit of knowledge," she says.

According to Moller, "There was more broadly a belief that the Greeks had a higher kind of knowledge. There was also certainly an element of anti-Islamic sentiment, the result of antagonism between Arabs and Christians in the period. But there was an Arab scholar from North Africa who translated a text into Latin in Italy and he did the same thing [in obscuring the non-Western contribution]. It was probably partly pragmatic: texts based on Greek knowledge would be more attractive to European scholars."

It is possible, though perhaps unlikely, that Champollion would have gone on to credit his sources at a later date. As Dr Daly notes, he died just 10 years after his breakthrough with the decipherment, and might have been tempted to revisit his publications. If he had, in addition to Ibn Wahshiyah, his bibliography

might have been named Athanasius Kircher. The German had provided other Western scholars with an important way into the earlier Arabic scholarship. Kircher had also made it clear that mastering Coptic was key to mastering hieroglyphs.

Coptic was a late Egyptian script that combined 24 Greek letters with seven Egyptian Demotic letters and was often used in academic contexts. A 13th-Century Egyptian scholar called al-Idrisi was among those to have drawn an early connection between this script and hieroglyphs. Several Arabic manuscripts from the same period as al-Idrisi were working indeed feature Coptic grammar guides and a number of these were introduced to the West. Kircher probed the connection between the two scripts further by mapping certain hieroglyphic symbols onto Coptic letters. In the process he

confirmed the earlier Arabic scholars' hypothesis that some hieroglyphs had phonetic meanings.

**A single sound, he showed, could be represented by more than one hieroglyph. This was not just a script, he realised, but a spoken language**

Champollion, following a similar path, initially downplayed the phonetic element of the script. His first thought was that hieroglyphs represented sounds predominantly when they were employed to write non-Egyptian names. Later, after his fainting episode, he realised that phonetics were in fact a central component of the script and could be used to denote Egyptian names too. A single sound, he showed, could be represented by more than one hieroglyph. This was not just a script, he realised, but a spoken language.

There is no denying that Champollion made an enormous contribution to the history of scholarship in making these discoveries. "Without Champollion," says Dr El Daly, "our knowledge would have had to wait a few more decades." His decipherment of the hieroglyphs on the Rosetta Stone facilitated the translation of hundreds of other previously incomprehensible texts down the centuries and therefore opened up countless new avenues of scholarship and debate. On a human level, too, Champollion clearly deserved the praise he received for his perseverance and intellectual clout.

But as we celebrate Champollion's grand achievement 200 years on, might we not also think of the other scholars who, though in many cases obscure today, through their own discoveries helped him on his way? It is arguable that the likes of Ibn Wahshiyah,

Athanasius Kircher and Thomas Young worked no less tirelessly to unpick the mysteries of the most mysterious of ancient scripts. Now is the time to put them back into the puzzle they embarked upon so zealously all those centuries ago.

*Daisy Dunn is the author of In the Shadow of Vesuvius: A Life of Pliny.*

*Hieroglyphs: Unlocking Ancient Egypt is at the British Museum from 13 October to 19 February.*

# 6 Easy Ways to Turn a Packet of Instant Noodles Into a Gourmet Meal

By **Kelly Plowe**

Instant ramen noodles on their own are nothing to write home about. They're high in sodium — as in, an entire package provides about 70 percent of your daily needs — and they offer very little by way of nutrients.

But what instant ramen noodles do provide is opportunity — a chance to get in some healthier foods like tofu, vegetables and even seaweed. Simply toss out the sodium-bomb flavor packet, and instead, use the noodles as a vehicle to pair with nutritious foods, all served up in a bowl of comforting soup.

We're sharing some of the best foods to pair with instant noodles from plant-based proteins to chicken and veggies.

Adding cubed tofu to instant noodles makes sense from a culinary perspective (it has a mild flavour, allowing the broth, spices and other add-ins to stand out) but it offers a lot nutritionally, too.

It's a plant-based protein made from soybeans and its creamy texture, almost like cheese, is satisfying. A half-cup serving of firm tofu clocks in at just 180 calories and provides 22 grams of protein, 3 grams of

fibre and 19 percent of your Daily Value (DV) of iron, according to the USDA.

You'll want to press or drain the tofu like you normally would before using. The great thing is you can add the tofu to your noodles raw or cook it beforehand (or even buy it pre-baked); it all depends on your preference. The recipe shared here calls for brown rice noodles but you can swap in instant ramen noodles instead.

**Recipes to try**

Aside from making your bowl of noodles more authentic, adding a soft-boiled egg or two adds tons of nutrition too.

We know eggs are a good source of protein — one large egg has about six grams — but it's also packed with riboflavin, vitamin B12, biotin, pantothenic acid, iodine, selenium and choline.

Make sure to cook the eggs before adding them to your instant noodles. You can soft-boil or hard-boil the egg and then add it to the broth when you're ready to enjoy.

**A recipe to try**

Soybeans are used to make tofu but young soybeans can be enjoyed whole as edamame. You'll most likely see them in the freezer aisle but you can sometimes find them fresh too.

They're a great source of plant-based protein, providing 19 grams of protein per one cup shelled, but they're a unique protein in that they also provide fibre (8 grams per cup, to be exact). Soybeans are nutrient-dense and packed with phytochemicals such as beta-carotene, lutein, zeaxanthin, isoflavones, phenolic acids and phytic acid.

Soybeans are easy to cook with, especially when it comes to instant noodles. You can add thawed edamame right into the broth as you're about to enjoy it.

**A recipe to try**

The sky's the limit when it comes to adding vegetables to instant noodles. Because of their mild flavour, the noodles allow veggies to star in any bowl.

Bok choy, asparagus, onions, mushrooms and leafy greens are great go-tos when throwing together a bowl of noodles.

A diet rich in vegetables (and fruits, too) is associated with lower blood pressure, reduced risk of heart disease and stroke, reduced risk of some cancers and improved weight management, according to Harvard T.H. Chan School of Public Health.

Aside from maybe leafy greens, you'll want to pre-cook the veggies before adding them to the instant noodles. The Thai Peanut Chicken Soba Noodle Soup (recipe below) uses extra-thinly sliced red peppers instead of cooking beforehand as a quick shortcut.

**A recipe to try**

Seaweed pairs perfectly with a bowl of instant noodles because the savoury flavour it provides helps cut down on the amount of salt you'll need to add to the dish. Plus, dried seaweed, like the type used in the recipe below, is filled with iron, magnesium and copper.

It's also a surprising heart-healthy food. Eating seaweed is associated with a lower risk of heart disease, according to an older study published in May 2011 in the *Journal of Agricultural and Food Chemistry*.

Adding dried seaweed to instant noodles is easy — simply sprinkle it on top before enjoying.

**A recipe to try**

Chicken breast is a great source of lean protein — a 3-ounce serving has 27 grams and clocks in at just 130 calories.

Eating more protein is especially helpful for weight loss or muscle gain. Getting more than the recommended 0.8 grams of protein per kilogram (2.2 pounds) of body weight can help us meet those goals, a December 2019 study published in *Advances in Nutrition* suggests.

Combining chicken with instant noodles takes an extra step because the chicken needs to be cooked first. You can try using a rotisserie or pre-cooked chicken in a pinch.

# Scientists have created a mechanical womb that can grow life in the lab

By **Miriam Fauzia**

The dystopian universe of *Blade Runner* features replicants, or genetically bioengineered people with sci-fi powers, like super-strength and advanced intelligence, that far outstrip any ordinary individual (albeit with a limited lifespan). Their invention is considered a colossal feat of scientific achievement (and the basis for a pretty messed-up society).

But off of the silver screen, we've yet to come close to making any organism — let alone a human — entirely from scratch. Until now.

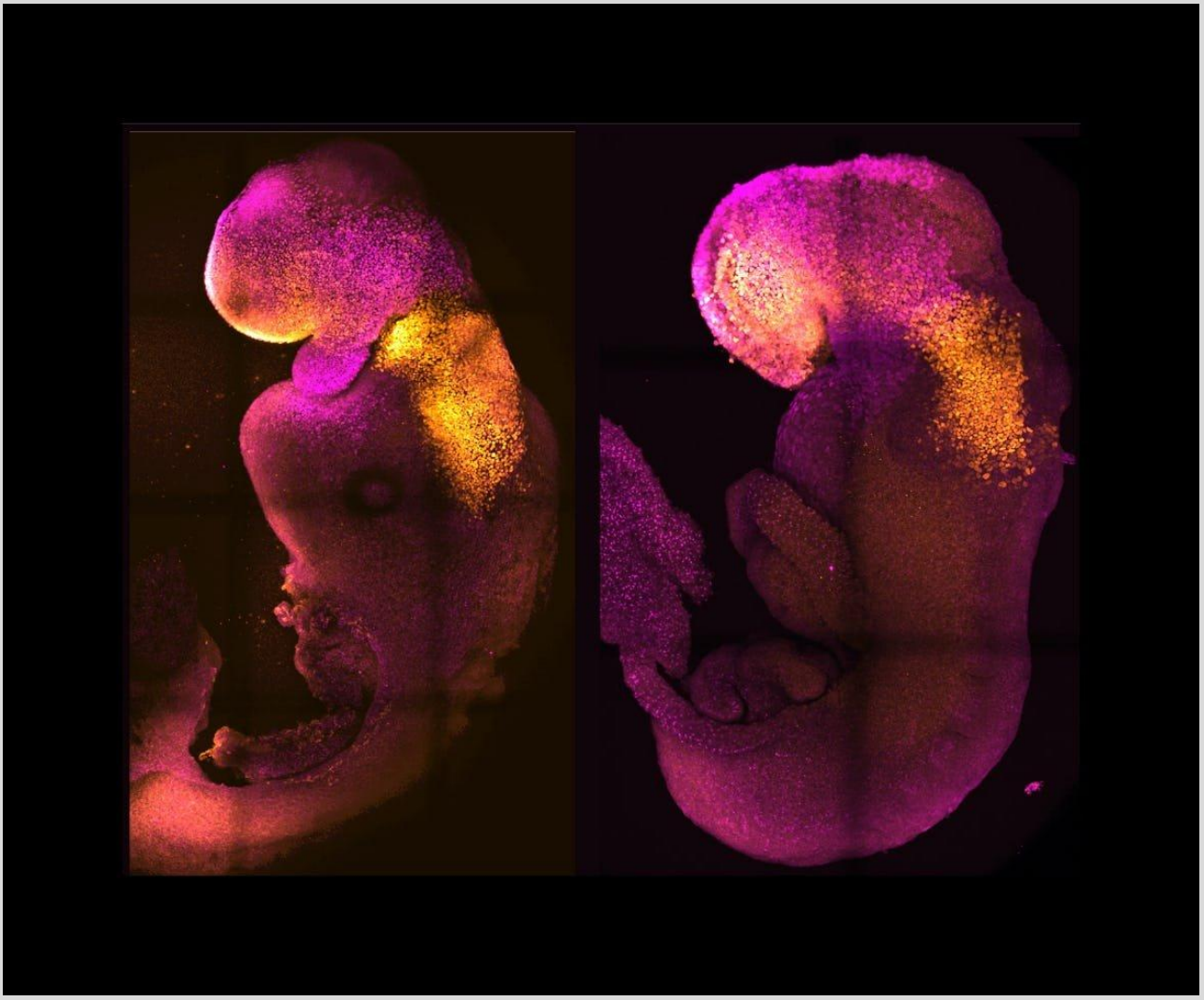
In a study published last month in the journal *Nature*, scientists in the U.S., U.K., and Israel successfully created a synthetic mouse embryo without using any eggs or sperm.

Instead, they used an assortment of stem cells.

Compared to natural embryos maturing alongside them, these lab-grown counterparts developed similar features seen nearly nine days after fertilisation, such as a beating heart, a very early-stage brain, and a gut tube — before they abruptly halted growth.

“Essentially, the big question that we are addressing in the lab is how do we start our lives?” said Magdalena Zernicka-Goetz, the study’s lead researcher and a stem cell biologist at the University of Cambridge and California Institute of Technology, during a press briefing.

## Peeking into the “black box”



*Researchers at the Weizmann Institute of Science in Israel managed to grow synthetic (left) and natural (right) embryos side-by-side in the lab.*

When a sperm fertilises an egg, the fusion sets off a cascade of changes that cause the single cell to multiply, specialise, and organise into distinct cell types, tissues,

organs, and other structures that constitute a complete organism.

For the last several decades, scientists have tried recreating models of embryonic development in the lab to learn how the primordial phenomenon proceeds in real time. But this feat has proven extremely challenging. After all, we can't just peer into a live uterus in the lab to directly observe the microscopic goings-on.

Specifically, researchers don't know what exactly happens in the womb between around 14 days and a month into development, says Max Wilson, a molecular biologist at the University of California, Santa Barbara, who was not involved in the study.

During this mystery period, the brain gets built and the heart is laid down. "It's called the 'black box' of human development," he explains.

Recent efforts to untangle these mysteries have involved coaxing human embryonic stem cells into blastocysts, a thin-walled, hollow ball of dividing cells that gives rise to the embryo during natural development.

This “blastoid” method didn’t exactly bring scientists closer to seeing how cells self-organise and specialise into organs. But in 2021, researchers at the Weizmann Institute of Science in Israel — who also worked on the new *Nature* study — developed a sort of mechanical womb (picture an axolotl tank à la Frank Herbert’s *Dune*).

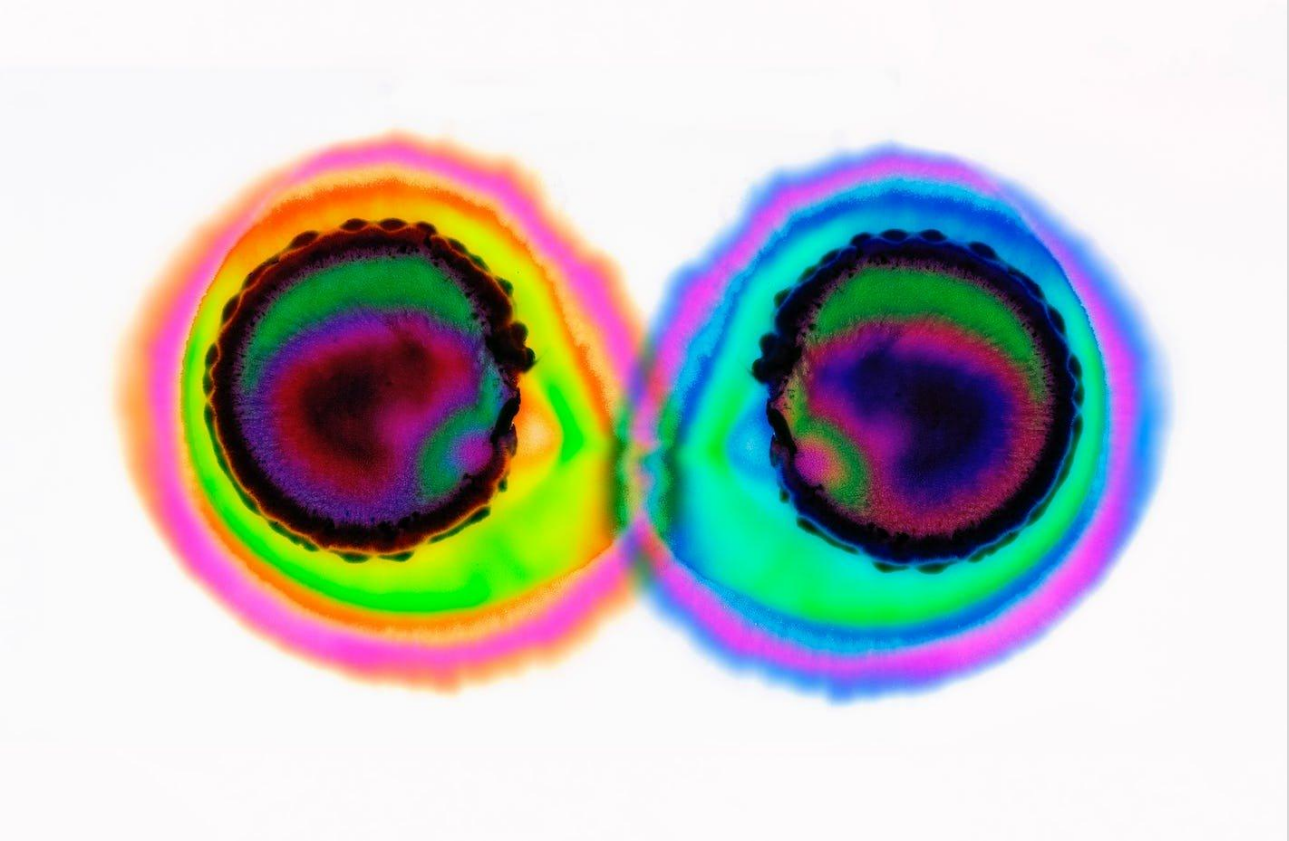
This device took seven gruelling years of engineering. It included an incubator, which floated and spun the embryos in vials filled with special nutrient-rich liquid. Meanwhile, a ventilator provided oxygen and carbon dioxide, meticulously controlling the gases’ flow and pressure.

With this setup, the Weizmann researchers managed to make stem cell-derived synthetic mouse embryos thrive in their artificial mommy for about six days — until they managed to extend it further, according to a study published earlier this month in the journal *Cell*.

The embryos underwent gastrulation (when an early embryo transforms into a multilayered structure) over the course of eight and a half days, but then stalled for unknown reasons. (A mouse pregnancy lasts for about 20 days.)

But the experiment wasn't entirely a dud. It set the mammoth task for the latest study: to show it was entirely possible to grow mammalian embryos outside the uterus.

## How to grow a baby



*Zernicka-Goetz and her colleagues used embryonic stem cells, along with those that give rise to the placenta and yolk sac, to grow synthetic embryos.*

Zernicka-Goetz, one of the authors behind the new *Nature* study, has spent the last decade investigating ways to develop synthetic embryos. She said her lab only initially used embryonic stem cells to mimic early development.

But in 2018, she and her colleagues discovered that if they tossed in two other stem cells that give rise to the placenta (the organ that provides nutrients and removes wastes) and the yolk sac (a structure that provides nourishment during early development), the embryos were better prepared for self-assembly.

Here's the thing about science: there's always competition. After their 2018 *Nature* paper, Zernicka-Goetz's team was surprised when the Weizmann group came out with an incubator-ventilator system, along with later experiments that forged embryos without sperm or eggs — just as they were attempting.

But science is also about collaboration. The two groups eventually teamed up to see whether combining their techniques could culminate in the life-creating golden ticket.

The results were impressive: Zernicka-Goetz and her colleagues watched the artificially wombed cells grow into synthetic “embryoids” without any sort of external modifications or guidance.

Compared to the natural mouse embryos that were grown separately, these embryonic mice went through the same stages of development up to eight and half days after fertilisation (just like the Weizmann team’s earlier work) which is equivalent to day 14 of human embryonic development.

The embryo model developed a head and heart — parts of the body researchers were never able to study in vitro, said Zernicka-Goetz.

“This is really the first demonstration of the forebrain in any models of embryonic development, and that’s been a Holy Grail for the field,” co-author David Glover, a research

professor of biology and biological engineering at Caltech, said during the press briefing.

Zernicka-Goetz's team also tinkered with a gene called Pax6, which appears to be a key player in brain development and function. After removing Pax6 from the mouse stem cell DNA with the help of CRISPR, Zernicka-Goetz and her colleagues observed that the heads of these synthetic embryos didn't develop correctly, mimicking what's seen when natural embryos lack this gene.

In humans, rare mutations or deletions of Pax6 can lead to abnormal development of the foetus and death. They can also spur conditions like aniridia (absence of the eye's colored part, the iris) or Peters anomaly, which hinders the development of eye structures like the cornea.

**A chance for synthetic life?**

The detailed glimpse into early embryonic development could be a boon to human health. For instance, it could help scientists grasp why many pregnancies, whether naturally conceived or via assisted reproductive means, fail in the early trimester.

Zernicka-Goetz said the research might also advance regenerative medicine. It could help scientists learn how to make viable, full-functioning replacement organs for a transplant patient using their own stem cells (potentially eliminating the need for lifelong use of immunosuppressants).

Currently, we have a broad sense of organogenesis — or the development of an organ from embryo to birth — but we don't know all the microscopic steps and cellular

interactions that culminate in a fully-fledged, functional organ.

The model system could aid the development of new drugs: It may reveal which medications are safe to take during pregnancy without harming the foetus. Now, researchers can potentially test them out on synthetic embryos, Zernicka-Goetz said.

“This is an advance but at a very early stage of development, a rare event which while superficially looking like an embryo, bears defects which should not be overlooked,” Alfonso Martinez Arias, a developmental biologist at Pompeu Fabra University in Spain who wasn’t involved in the study, said in a press release.

One glaring challenge: While the synthetic mouse embryos appear identical to their natural counterparts, their stalled development at eight and a half days makes

it tough to say whether they'd continue to grow right on course.

So despite its enormous potential, fashioning synthetic embryos from stem cells just isn't possible right now.

"This blockade is not understood and needs to be overcome if one desires to grow mouse synthetic embryos past day eight," Christophe Galichet, a stem cell biologist at Francis Crick Institute in London who also wasn't involved in the new work, said in the same press release.

Since humans and mice don't exactly share all the same characteristics when it comes to embryonic development, the next step is to eventually concoct synthetic embryos from human stem cells.

That likely will prove complicated, more so ethically than technique-wise. But Wilson

thinks this research marks a major scientific milestone and tool to add to humanity's technological toolbox.

"This is very strong evidence that we will one day have this power, and it will be possible [to create synthetic life]," Wilson says. "Whether we decide to do that or not because of ethics or even the potential upsides — that's a question for society at large."

Concluded