

SCIENTIFIC AMERICAN

The Quantum
Observer

Ozempic and
the Brain

Asteroid Rubble
Rewrites History

The New Science of Health and Appetite

What humans really evolved
to eat and how food affects
our health today



ADVANCES

SCIENCE IN IMAGES

Magnetism vs. Gravity

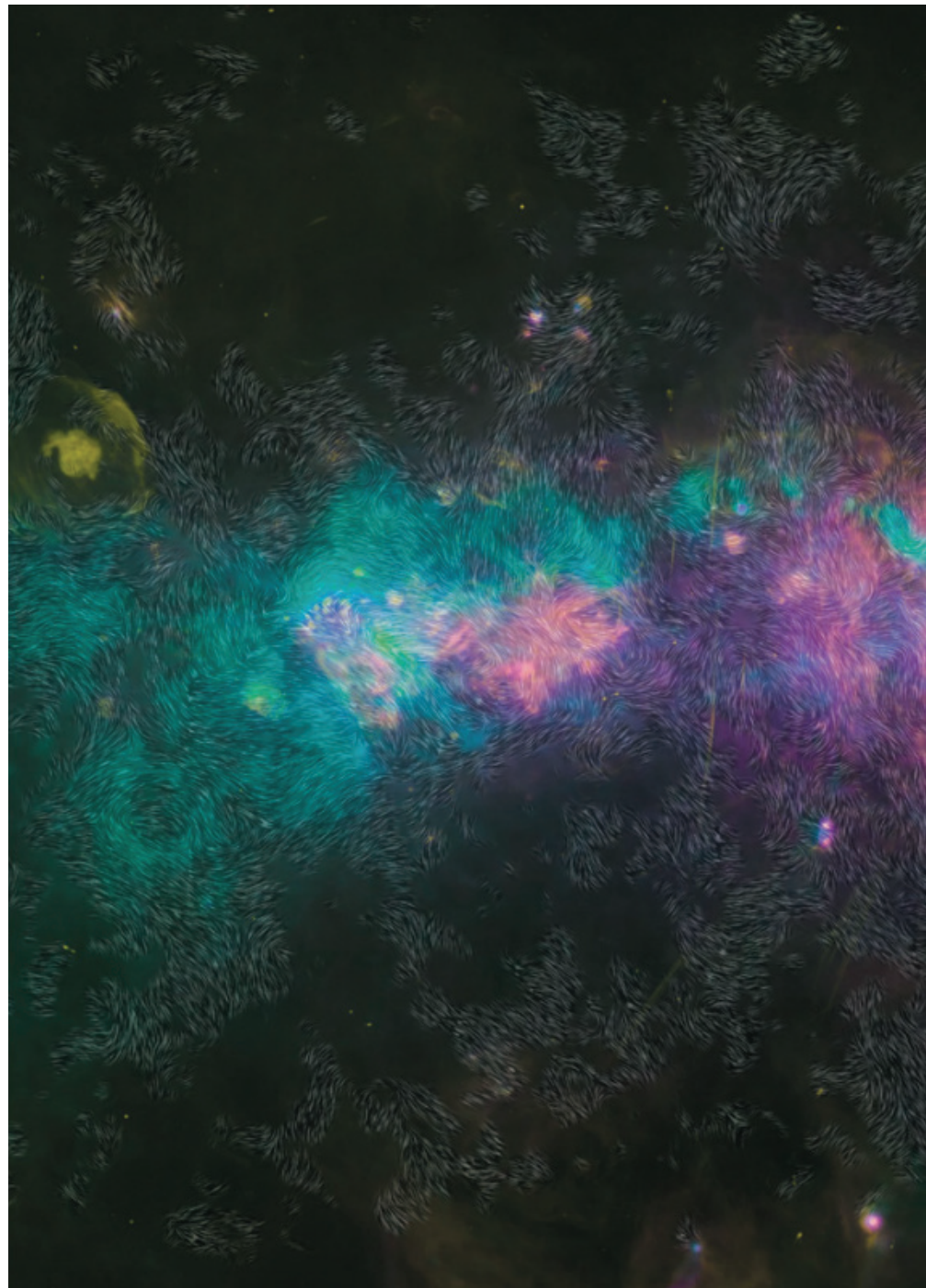
Colorized data show how clashing cosmic forces built the Milky Way

OUR GALAXY TOOK SHAPE more than 13 billion years ago, when clouds of cosmic dust collapsed from their own gravitational pull, and the resulting heat and pressure slowly transformed them into stars and planets ... or something like that. [Details of the Milky Way's origin story](#) are still fuzzy, and studying this ancient process is exceptionally tricky.

But a new map of the galactic center and its magnetic field offers scientists an unprecedentedly detailed look into the forces that powered our galaxy's emergence. Researchers around the world spent four years gathering and combining telescope data that show how interstellar dust 500 light-years from Earth interacts with the galaxy's magnetic field. The resulting map is the first to depict the field with such clarity at this resolution, says the project's principal investigator, Villanova University physicist David T. Chuss.

Chuss and his team studied space dust using the Stratospheric Observatory for Infrared Astronomy, a NASA telescope that [tracked infrared light while mounted in an aircraft](#) flown at 45,000 feet. Magnetic fields cause light waves emitted by dust to orient in particular ways, giving that light a property called polarization—so measuring the polarization can reveal nearby magnetism. Villanova physicist Dylan Paré and his colleagues converted the telescope's data into segments suitable for visual representation, and Kaitlyn Karpovich, then an undergraduate student, crafted the colorful background using additional telescopes' data on dust temperature and dispersion.

The colors symbolize different particle



temperatures: blue and purple indicate cold and warm dust, respectively, and yellow denotes hot gas. The small, swirling gray lines represent the magnetic field. “I’m still pretty

astounded at how complex the field is,” Chuss says. “I stare at this map a lot but am still always noticing new things about it.”

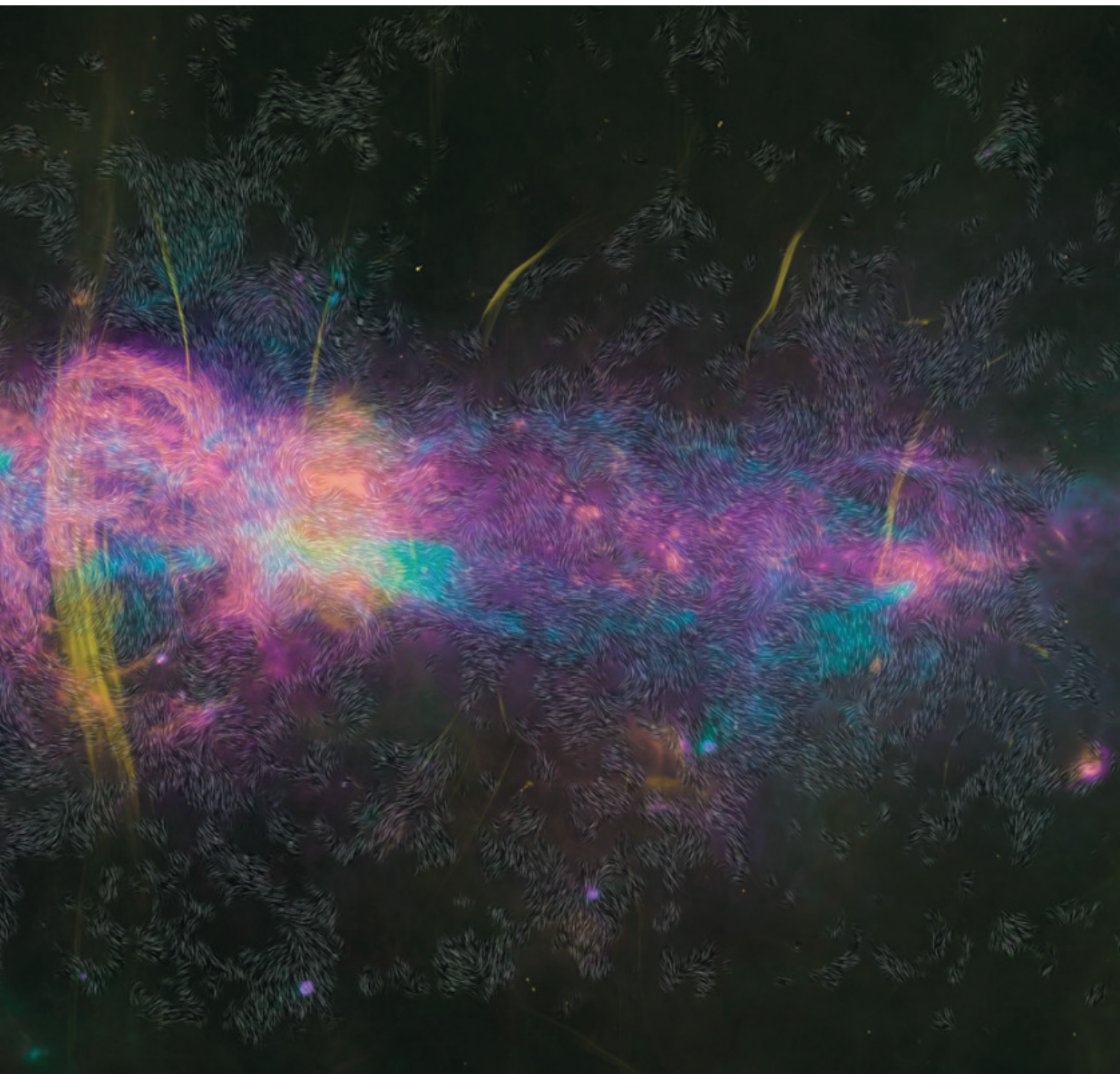
Astronomer Roberta Paladini of the

CRISPR ENABLES
A FAST, POWERFUL
DIAGNOSTIC TEST P. 12

PAINT THAT CLEANS
ITSELF AND MAYBE
THE AIR P. 15

APES SPEND YEARS
LEARNING TO BUILD
THEIR NESTS P. 18

DISPATCHES FROM THE FRONTIERS OF SCIENCE, TECHNOLOGY AND MEDICINE



D. Paré, K. Karpovich and D. Chuss/Villanova University (PI); Three-color background image also uses data from European Space Agency (ESA), Herschel Space Observatory and South African Radio Astronomy Observatory (SARAO) and MeerKAT Radio Telescope

California Institute of Technology says studying Milky Way dust can illuminate the elaborate interplay between gravity and magnetism, helping scientists inves-

tigate when and why dust clouds collapse to form stars. “When we have these two forces working in balance, the cloud doesn’t collapse,” she says. “But at some

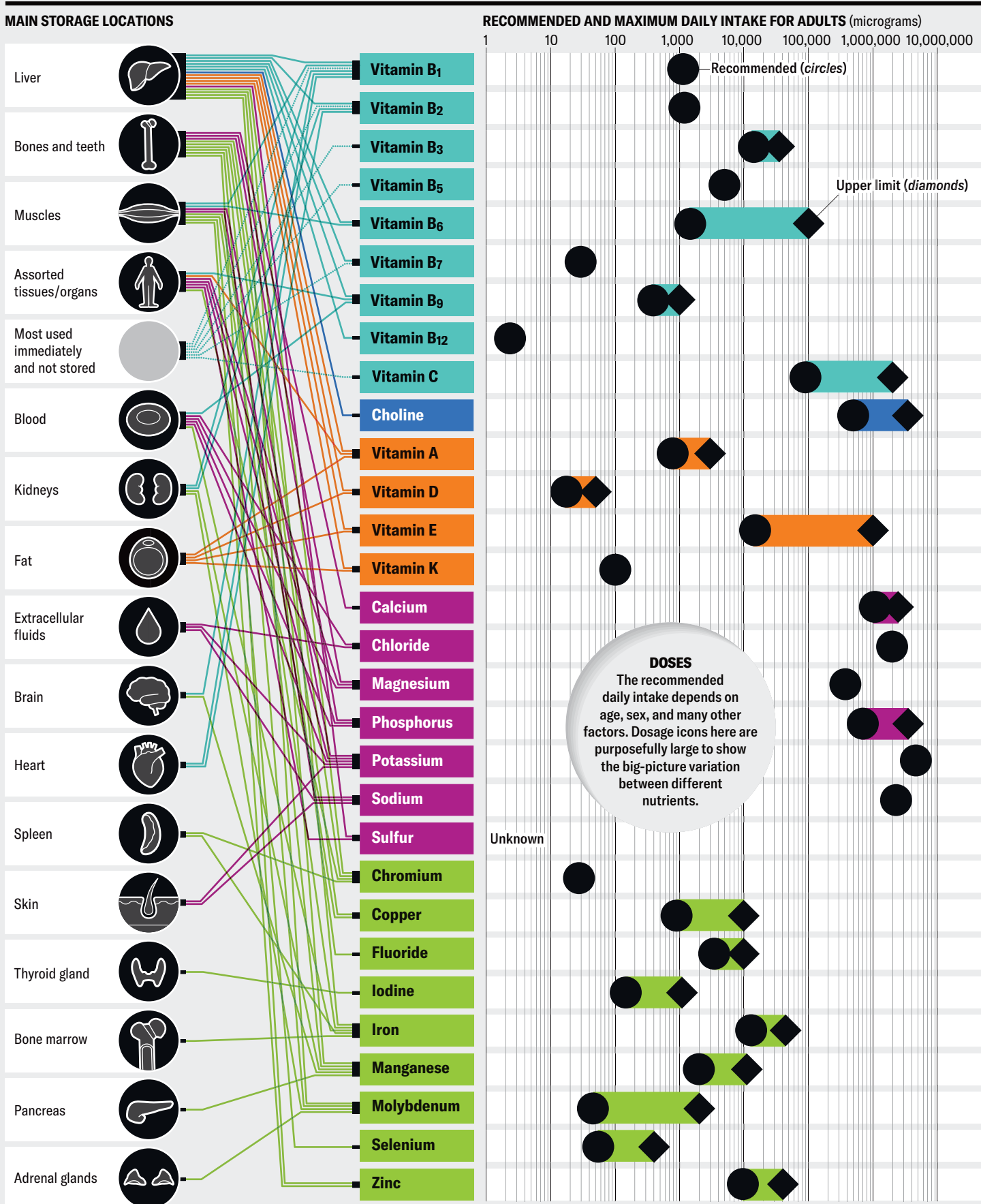
point gravity always wins—and examining magnetic fields will help us know when collapse actually happens and stars emerge.”
—*Riis Williams*

KEY FUNCTIONS

- Helps to turn food into energy. Promotes skin, hair, muscle and brain health. Critical for nerve function.
- Helps to turn food into energy. Boosts skin, hair, blood and brain health.
- Helps to turn food into energy. Essential for healthy skin, blood cells, brain and nervous system.
- Helps to turn food into energy. Helps to produce lipids, neurotransmitters, steroid hormones and hemoglobin.
- Metabolizes amino acids and helps cells replicate. Helps to produce red blood cells and neurotransmitters essential for brain function.
- Helps to convert food into energy and make glucose. Helps to build and break down some fatty acids. Promotes bone and hair health.
- Metabolizes amino acids and helps cells multiply. Vital for new cell creation. Helps to prevent brain and spine birth defects when taken early in pregnancy.
- Metabolizes amino acids and helps cells multiply. Protects nerves and encourages their growth. Helps to build red blood cells and DNA.
- Makes collagen, as well as the neurotransmitters serotonin and norepinephrine. Works as an antioxidant. Boosts the immune system.
- Helps to make the neurotransmitter acetylcholine. Aids in metabolizing and transporting fats.
- Important for vision, cell health, bone formation and immune system function.
- Helps to keep calcium and phosphorus at normal levels in the blood. Assists in forming teeth and bones.
- Acts as an antioxidant, aids the immune system and supports vascular health.
- Aids in bone formation. Activates proteins and calcium essential for blood clotting.
- Helps to build and protect teeth and bones. Aids with muscle function, blood clotting, nerve impulse transmission, hormone secretion and enzyme activation.
- Balances fluids in the body and forms part of the stomach acid, which helps to digest food.
- Necessary for chemical reactions in the body. Aids in muscle contraction, blood clotting and regulation of blood pressure. Helps to build bones and teeth.
- Builds and protects bones and teeth. Forms a part of DNA and RNA. Helps to convert food into energy. Helps to move nutrients into and out of cells.
- Helps to balance fluids in the body. Helps to maintain a steady heartbeat and send nerve impulses. Required for muscle contractions.
- Helps to balance fluids in the body. Helps to send nerve impulses. Needed for muscle contractions. Impacts blood pressure.
- Helps to shape and stabilize protein structures. Necessary for healthy hair, skin and nails.
- Boosts insulin activity, helps to maintain normal blood glucose levels, and is required to free energy from glucose.
- Important for iron metabolism and the immune system. Helps to make red blood cells.
- Strengthens bones and stimulates new bone formation. Prevents tooth decay.
- Necessary for synthesizing thyroid hormones, which help to maintain body temperature and influence nerve and muscle function.
- Helps to transport oxygen through the body. Required for chemical reactions in the body and for making amino acids, collagen, neurotransmitters and hormones.
- Helps to form bones and metabolize amino acids, cholesterol and carbohydrates.
- Forms part of several enzymes, including one that protects against potentially deadly neurological damage in infants.
- Acts as an antioxidant and helps to regulate thyroid hormone activity.
- Helps to form enzymes and proteins and to build new cells. Frees vitamin A from storage in the liver. Vital for the immune system, taste, smell and wound healing.

FUNCTION

Listed here are the main known uses of different nutrients, although scientists suspect there are many that are undiscovered. Furthermore, vitamins and minerals often interact with one another and help to promote the reactions of other nutrients.



RICH FOOD SOURCES

Pork, brown rice, soy milk, watermelon, acorn squash	Vitamin B ₁
Meat, milk, eggs, yogurt, cheese, green leafy vegetables	Vitamin B ₂
Meat, poultry, fish, whole grains, mushrooms, potatoes, peanut butter	Vitamin B ₃
Chicken, egg yolk, whole grains, broccoli, mushrooms, avocados	Vitamin B ₅
Meat, fish, poultry, legumes, tofu, potatoes, bananas, watermelon	Vitamin B ₆
Whole grains, organ meats, egg yolks, soybeans, fish	Vitamin B ₇
Asparagus, okra, spinach, turnip greens, broccoli, legumes, orange juice, tomato juice	Vitamin B ₉
Meat, poultry, fish, milk, cheese, eggs	Vitamin B ₁₂
Fruits (especially citrus), potatoes, broccoli, bell peppers, spinach, strawberries, tomatoes, brussels sprouts	Vitamin C
Milk, eggs, liver, salmon, peanuts	Choline
Liver, fish, eggs, sweet potatoes, carrots, pumpkins, squash, spinach, mangoes, turnip greens	Vitamin A
Fortified milk or margarine, fortified cereals, fatty fish (Your body also uses sunlight to make vitamin D.)	Vitamin D
Vegetable oils, wheat germ, leafy green vegetables, whole grains, nuts	Vitamin E
Cabbage, liver, eggs, milk, spinach, broccoli, sprouts, kale, collards, other green vegetables	Vitamin K
Yogurt, cheese, milk, tofu, sardines, salmon, fortified juices, broccoli, kale	Calcium
Salt (sodium chloride), soy sauce, processed foods	Chloride
Spinach, broccoli, legumes, cashews, sunflower and other seeds, halibut, whole wheat bread, milk	Magnesium
Milk and dairy products, meat, fish, poultry, eggs, liver, green peas, broccoli, potatoes, almonds	Phosphorus
Meat, milk, fruits, vegetables, grains, legumes	Potassium
Salt, soy sauce, processed foods, vegetables	Sodium
Protein-rich foods, such as meat, fish, poultry, nuts, legumes	Sulfur
Meat, poultry, fish, eggs, potatoes, some cereals, nuts, cheese, brewer's yeast	Chromium
Liver, shellfish, nuts, seeds, whole-grain products, beans, prunes, cocoa, black pepper	Copper
Fluoridated water, toothpaste with fluoride, marine fish, teas	Fluoride
Iodized salt, processed foods, seafood	Iodine
Red meat, poultry, eggs, fruits, green vegetables, fortified bread and grain products	Iron
Fish, nuts, legumes, whole grains, tea	Manganese
Legumes, nuts, grain products, milk	Molybdenum
Organ meats, seafood, walnuts, sometimes plants (depends on soil content), grain products	Selenium
Red meat, poultry, oysters and some other seafood, fortified cereals, beans, nuts	Zinc

DELICATE BALANCE

When we eat too much of one vitamin or mineral, it can cause the loss of another. For instance, an excess of sodium will deplete calcium because these nutrients bind together, causing the body to excrete them both when it flushes out the sodium.

GETTING ENOUGH

In the U.S., nutrition deficiencies are relatively rare, although malnutrition is increasing, especially among older age groups. The most common deficiencies are of vitamin B₆, iron and vitamin D. Of all the vitamins and minerals, Americans are least likely to be deficient in vitamin A, vitamin E and folate (B₉).

BENEFICIAL COMBINATIONS

Some nutrients work best as a team. Vitamin D helps us absorb calcium, for instance, and potassium encourages the excretion of excess sodium. Folate (B₉) is best absorbed if B₁₂ is around, and the two work together to help cells divide and multiply.

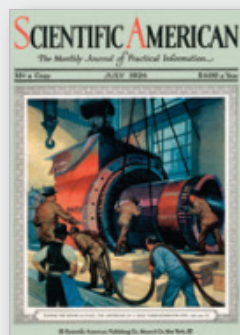
50, 100 & 150 Years



THE SAWFLY'S BARF DEFENSE

1974

"Many insects regurgitate or defecate when they are threatened, a phenomenon familiar to almost anyone who has held a grasshopper in their hand. It is believed that such discharges help to protect the insect against predation. When the larva of the sawfly is disturbed, it quickly turns and dabs a droplet of a viscous resin from its mouth on the offending object. This oral effluent is obnoxious to many predators; ants and spiders promptly flee. The sawfly larva feeds on the needles of conifers, including the lower portion, which contains resin from the branch. The resin repels other insects, part of the tree's own defenses against attack."



DEATH RAYS NO ONE KNOWS

1924

"Every so often we are startled by reports of a new ray with strange and terrifying properties, intended for such gentle tasks as paralyzing airplanes in flight,

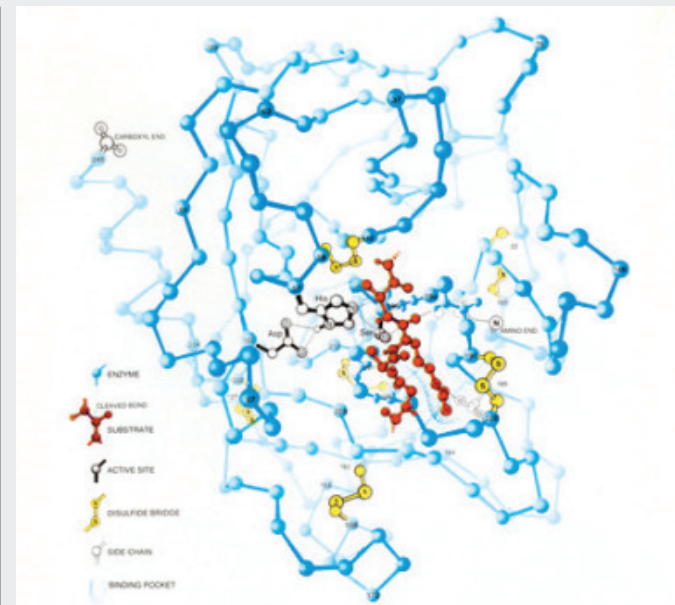
blowing up battleships and killing enemy troops by the wholesale. The mysterious ray is a true perennial of science. It was talked about when Nikola Tesla experimented with high-frequency currents in 1898 and put out of commission the generators in a power house several miles away. Almost a year ago a French inventor is said to have demonstrated a mysterious ray which caused Parisian taxicabs to stop. Recently, the garrulous Leon Trotsky has told the world to beware of a new Russian death ray. Guglielmo Marconi, from time to time, has been working on some mysterious ray for destructive purposes, according to rumor. What are these diabolic rays? No one except their sponsors really knows. We are given no proof, except a few unimpressive laboratory experiments. Groping about in pitch blackness, we are frankly, skeptical."



PERILS OF NITROGLYCERIN

1874

"Nitroglycerin is a thick, colorless oil. People are so accustomed to handling oils that it is almost impossible to make them realize the danger that lurks even in the smallest quantity of nitroglycerin. It explodes when gently struck, and is 10 times more powerful as an explosive than gunpowder. The other evening, in Jersey City, a gentleman and lady were taking a moonlight stroll in the vicinity of one of the shafts of the new Delaware



1974, Protein Cutter: "Trypsin and a substrate fit together like pieces of a three-dimensional jigsaw puzzle." Trypsin is an enzyme that aids with digestion by breaking chains of amino acids in proteins.

and Lackawanna railway tunnel. The man saw on the ground the glimmer of a small tube, picked it up, and slapped it from one hand to the other, when a terrific explosion ensued. His eyes were destroyed, his limbs broken, and his companion was dreadfully injured. It was a discarded nitroglycerin tube, such as are used in blasting, and is supposed to have been thrown away."

OXYGEN CENTENNIAL

"We have alluded to the proposition of Dr. H. Carrington Bolton, of Columbia College, of a reunion of chemists to celebrate the hundredth anniversary of the birth of modern chemistry, that event being fixed in 1774, owing to the discoveries, at that time, of oxygen by Joseph Priestley, chlorine by Carl Wilhelm Scheele and other important investigations by Antoine Lavoisier. The day set apart is August 1, in Northumberland, Pa., where Priestley's remains are buried."

PROHIBITION, 46 YEARS HENCE

"There is a substance that has been the cause of more sorrow, crime and suffering than all

other evil agencies that have afflicted the world. It has caused tens of thousands of murders and uncounted instances of robbery, theft, arson and suicide; it has brought misery and want into millions of households. What an awful indictment against a substance which stands so closely allied in chemical relationship to innocent sugar! Alcohol is not a natural product; it can only result from a ferment. If this chemical change had been impossible, the human race would have been saved from shedding tears, the aggregated volume of which reaches that of a mighty river. We unhesitatingly declare that the world in its present advanced stage has no need of alcohol. Why not then make a determined effort to rid the country and the world of the monster? There is virtue and moral force enough to compel Congress to prohibit its importation, and enough in most States to compel legislatures to prohibit its manufacture." *In the U.S., prohibition of the manufacture, transport and sale of alcohol lasted from 1920 to 1933.*

Are insurance companies doing enough to manage climate risk?

Learn how insurance companies can reduce their financial exposure to climate risks with our cutting-edge reports and tools.



Visit ceres.org/insurance or scan the QR code for actionable insights.

 **Ceres Accelerator**
FOR SUSTAINABLE CAPITAL MARKETS

Explore Egypt



With the world's most renowned archaeologists

Dr. Mostafa Waziri
One of Egypt's Heads of Antiquities

Dr. Khaled El-Enany
Egypt's First Minister
of Tourism & Antiquities

“ No one can tour Egypt like this –
except for you, when you come and join us!

Dr. Zahi Hawass
World's Most Famous Archaeologist

Enjoy exclusive
VIP access
to Egypt's
greatest wonders

- ★ VIP tour of the Grand Egyptian Museum, the largest archaeological museum in the world
- ★ Private visits to the Giza Pyramids and Luxor Temple for a crowd-free experience
- ★ A chance to stand between the paws of the Great Sphinx instead of seeing it from a distance
- ★ Private entry to the Great Pyramid of Khufu, with a visit to chambers closed to the public
- ★ Private entry to the Valley of the Kings and King Tut's Tomb
- ★ Tours of active excavation sites, including the newly discovered Lost Golden City
- ★ Special access to Taposiris Magna Temple, the likely long-lost resting place of Cleopatra
- ★ And many more once-in-a-lifetime experiences!



Travel in true royal style – stay in historic hotels, sail on a luxury Nile cruiser and savor the finest cuisine.

START YOUR EXTRAORDINARY TOUR OF EGYPT TODAY

🌐 www.ArchaeologicalPaths.com ✉ contact@archaeologicalpaths.com ☎ 917-724-2772

