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2014 PA STATE STEM DESIGN CHALLENGE

By Celeste Beley



the state with over 2,000 students and 250 teachers participating. From those regional competitions, more than 300 students in grades 3-8, all first or second place winners in their regional competitions, designed, constructed and presented their creations to judges from Thermo Fisher Scientific, K'Nex and AquaPhoenix Education.

Working in teams of four, students were challenged to build environmentally friendly people movers. Their creations had to travel 4' across a surface and overcome at least one obstacle. The people movers had to be created from no more than 1800 K'Nex pieces and use at least one motor. Students also had to demonstrate their methodology and process in coming up with the design, including a narrative, blueprints and a presentation to the judges. Teams were scored on creativity, overall design, blueprint, narrative, presentation and teamwork.

Pennsylvania Governor Tom Corbett spoke to the participants on the importance of STEM education, saying, "The more you can be exposed to science, technology, engineering and math, the better you're going to have a chance to have a great job when you get older and to have the money to raise a family and provide for them. And that's what this is about. Every generation is providing for the next generation. Every generation is going to bring new inventions."

On May 2, 2014, some of the best and brightest students in Pennsylvania united in Harrisburg to compete in the first ever Pennsylvania State Thermo Fisher Scientific STEM Design Challenge held at Harrisburg University of Science and Technology. The program was originally designed and implemented by Amy Cribbs, Career Education and Academic Events Coordinator at the Allegheny Intermediate Unit (AIU). With sponsorship from Thermo Fisher Scientific, this year the challenge expanded to include 19 of 29 intermediate units across

THERMO FISHER SCIENTIFIC PA STATE STEM DESIGN CHALLENGE WINNERS

GRADES 4-5

- 1st *Northwestern Elementary* – IU5 Northwest Tri-County
- 2nd *East Vincent* – IU24 Chester County
- 3rd *Fox Township Elementary* – IU9 Seneca Highlands

Honorable Mentions:

- Hamilton Heights Elementary* – IU12 Lincoln
- Lackawanna Trail Elementary* – IU19 Northeastern
- Tinicum School* – IU22 Bucks County
- Ben Franklin Elementary* – IU28 ARIN

GRADES 6-8

- 1st *Southern Columbia Area Middle School* – IU16 Central Susquehanna
- 2nd *Hampton Middle School* – IU3 Allegheny
- 3rd *East Vincent* – IU24 Chester County

Honorable Mentions:

- William Penn Middle School* – IU22 Bucks County
- Beaver Area Middle School* – IU27 Beaver Valley
- David E. Williams Middle School* – IU3 Allegheny
- Austin Area* – IU9 Seneca Highlands



PUPPY LOVE: DO DOGS REALLY FEEL THEIR OWNERS' PAIN?

By Patti Dobranski



It is a love story some 15,000 years in the making: dogs are man's best friend. But does the bond between dogs and their owners prove canines have emotions? From sad puppy eyes to a sloppy kiss, dogs seem to know when a human is troubled and

But in a 2006 experiment, researchers enlisted participants who faked heart attacks or appeared to be stuck underneath furniture, only to find not one of the pet dogs attempted to save them. They acknowledged, however, that rescue is a more complex task than an emotional reaction.

In the recent University of London study published in the May 30 edition of the journal *Animal Cognition*, researcher and psychologist Deborah Custance and her colleague, Jennifer Mayer, gathered 18 pet dogs and their owners. Their test subjects were a collection of mutts and some common pure breeds, and the study was quite simple. They decided to see if the canines would react to crying in an empathetic manner.

In each of the owners' living rooms, Mayer entered and proceeded to ignore the animals so they would not be attracted to her. She and their owners then took turns "crying" (sad) and humming (happy) — two very different emotions — to garner a reaction from the dogs.

Not surprisingly, 15 of the 18 dogs approached the "crying" person and even adopted a submissive demeanor along with it. But were they really attracted to the unhappy person because they knew they would get affection from their owners for this action?

WHAT DOES THIS ALL MEAN?

"The humming was designed to be a relatively novel behavior, which might be likely to pique the dogs' curiosity," Custance said. "The fact that the dogs differentiated between crying and humming indicates that their response to crying was not purely driven by curiosity. Rather, the crying carried greater emotional meaning for the dogs and provoked a stronger overall response than either humming or talking," she said.

While Custance concluded the experiment offered no definitive proof dogs feel love or are empathetic to human pain, it does provide data for future tests between breeds or involving other human emotions.

how to offer their own brand of unconditional comfort.

IS IT REAL, OR JUST "PUPPY LOVE"?

This seemingly emotional behavior led scientists from the University of London to see if it is just an instinctive response or true empathy. The results proved interesting, but whether dogs feel for their humans still remained a mystery.

THE EXPERIMENT

Past studies have shown dogs have great finesse with human communication. Gestures and verbal commands are typically understood and followed (in most cases) by our canine companions.

VOCABULARY

- Empathy
- Submissive

EXTENSION QUESTIONS

- Have you ever had an experience with a dog that made you believe they really did love you and feel your pain?
- Have you ever heard the expression, "All Dogs Go to Heaven"? Why do you think this expression came to be? Do you think this supports the idea of canine empathy?

NOW YOU CAN RUN IN THE SCHOOL HALLWAY

By Samba Lampich



A Riverdale School student holds up one of the LED boards installed with the PaveGen tiles

outside the school's cafeteria included eight ramped tiles, two LED boards that give information about the technology and light up when students step on the tiles, a monitor that displays how much energy is produced when the tiles are stepped on and a charging stand used specifically to charge cell phone with the energy produced by footsteps.

GREEN UNDER STUDENTS' FEET

The tiles capture the kinetic energy of students stepping on them and convert it into electricity that powers school lights and charges small devices. When students walk on the tile, the top flexes about 5mm, capturing kinetic energy which can be stored in lithium batteries or used immediately as electricity.

The tiles light up when stepped on, letting the student know how much energy their step produced — usually between one to seven watts — enough to charge a cell phone for a little more than 30 seconds.

While students enjoy jumping and

running on the tiles, the ultimate goal of the installation was to educate students about energy production and consumption.

"It's really to make people aware of a unique approach to sustainability," explains Zach Halem '14, the student who made the installation possible. "We also hope to use the installation to experiment with the technology, as we may possibly plan for an embedded installation that would save energy and money in new construction in the future."

THE GREEN CYCLE

The brainchild of 26-year-old British industrial designer Laurence Kembell-Cook, PaveGen tiles have been installed in many places across Europe. Other

kinetic energy harvesting systems are not based on piezoelectricity, which relies on high spikes, making it difficult to get a consistent flow of energy. Instead, Kembell-Cook says the PaveGen tiles are a hybrid of piezoelectricity and a proprietary alternative technology.

The top surface of the tile is made from 100% recycled rubber and the base from more than 80% recycled materials. The tiles can be retrofitted in place of existing flooring or custom designed for new spaces. The first designs were aimed at illuminating small spaces like bus stops, ticket machines, refrigerators and shop signs. They have even been installed in a marathon track in Paris. They are also weatherproof and are ideal for outdoor public spaces that see a lot of foot traffic.

VOCABULARY

- Kinetic Energy
- Watt
- Piezoelectricity

EXTENSION QUESTIONS

- What other settings, venues or locations would be ideal for installing PaveGen tiles?
- If you had PaveGen tiles in your school where would you install them? How would you encourage students to step on them?

SOCCER STARS WIN WITH PHYSICS

By Cara De Carlo

"Soccer is one of those sports where there's a ton of math and science," explained Pine-Richland Lady Rams Varsity Head Coach Jodi Chmielewski. Pine-Richland is located north of the city of Pittsburgh, PA. Chmielewski is also a sixth grade math and science teacher at Pine-Richland.

In 2005, outside midfielder Meghan Klingenberg used the physics of soccer to help lead Pine-Richland to a Pennsylvania state championship.

"Why she was so successful..." said Chmielewski, "She knew those angles — those right times to cut in toward the goal from that sideline."

In other words, Klingenberg had amazing control over her shot angle from goal-line center. After Pine-Richland, she went on to play for the University of North Carolina, where she scored 18 goals and made 24 assists. Klingenberg now plays professionally for the U.S. National team, as well as well as the professional Houston Dash.

"The percentage [of successful direct shots on goal] decreases when you go out from the middle toward the end line," Chmielewski summarized. If you picture "sun rays" emanating outward from the goal until they hit the field boundaries, those rays mark the pathways of most probable scoring. The closer you get to the goal, the less likely you are to score with a shot down the middle.

Chmielewski also explained that the physics of individual player's corner kicks dictates the corner's finish. As the team sets up to finish the corner for a goal, they have to know which direction the ball will curve. Teams must account for "in-swingers" and "out-swingers."

"It depends on what foot [the kicker] is striking the ball with," said Chmielewski, adding that the side from which they're kicking is also important. The "English" or "spin" on a kick causes the ball to slice like a golf ball. The slice could go toward the goal or away from it.

"A team has to know its players and to know what side of the field the corner is from — so they can adjust the run."



Peters Township alumna Veronica Latsko in Fall 2012. Latsko, a Virginia recruit, was a two-time Gatorade Pennsylvania Girls Soccer Player of the Year. (Latsko has spent the past season rehabilitating an ACL tear.)

EXTENSION QUESTIONS

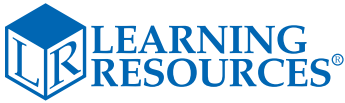
- What concepts in soccer can you come up with that demonstrate classical concepts in physics?

EXAMPLES:

- An airborne free-kick from midfield — Parabolic motion
- A ball hitting the materials that make up someone's header guard — energy transfer
- You're the trainer, and your team's star striker is prone to hamstring tightness. How do you help prevent injury?

VOCABULARY

- Angle of incidence
- Parabolic motion
- Corner kick
- Striker
- Free kick



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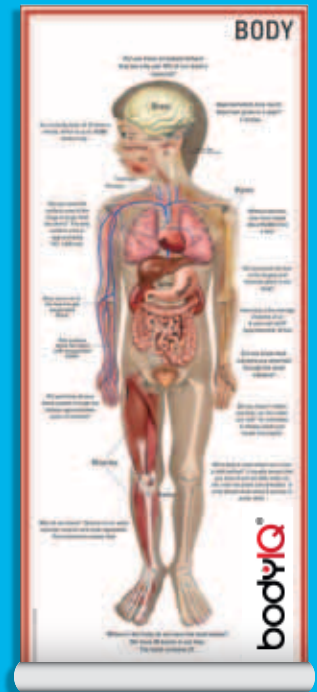


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MOBILE DEMO UNITS

URINE RECYCLING MAKES MARS TRAVEL EASIER

By Mona Simpson



Did you know that people urinate about 50% more liquid each day than they drink? How, you may ask? Well, part of it is because your body turns some of your food into water. Burning carbohydrates creates energy, as well as some carbon dioxide and water, which adds to the water that your body ingests.

Water consumption is important here on earth, but it is even more critical to make sure you have sufficient water when you're an astronaut isolated in space. It costs a great deal (up to \$10,000 per pound) to deliver supplies to places like the International Space Station, and astronauts who perform long-term space missions, such as traveling to Mars, will need to be able to reuse and recycle the items they take with them in order to reduce cargo. Human wastewater could be over 50% of the total waste per person on lengthy space missions.

There are three sources of water that scientists reclaim and reuse: humidity condensate, hygiene water, and urine wastewater. Since 2010, astronauts living aboard the international space station have been recycling their wastewater, including urine, in real time. Now researchers have found a more efficient method. This research showed that it was possible to turn wastewater into purified water more efficiently — and get energy as well.

The new system uses a chemical process called osmosis to remove water from the urine. Urea remains behind. Urea could be used as a fertilizer or as a raw ingredient in some fuel systems. But in this case, enzymes in the bioreactor tank convert the remaining urea into ammonia. That ammonia drives a fuel cell, using chemicals to produce electricity.

Now before you turn up your nose at the idea of drinking recycled wastewater, you should note that the water the astronauts purify is likely more pure than than the water you drink each day.

Now, this technology can allow astronauts, well as people in developing countries—where water is scarce, to have an even more efficient system to purify wastewater, and an energy source as well.

VOCABULARY

- Ammonia
- Fuel cell
- Urea

EXTENSION QUESTIONS

- What is a proof of concept?
- How much water have you used today? How much water does the average household use each day?

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SCIENTISTS BUILD FIRST FUNCTIONAL DESIGNER CHROMOSOMES

By Samba Lampich

Researchers from New York University have made a tremendous breakthrough in the genetics field by building an entire chromosome from scratch. Dr. Jef Boek and his team used a computer to redesign one of the 16 chromosomes found in the brewer's yeast, *Saccharomyces cerevisiae*.

This discovery, described in the March 27 edition of *Science*, was a seven-year effort and involving 60 undergraduate students enrolled in the "Build a Genome" project founded by Boeke at Johns Hopkins.

Although scientists have built bacterial chromosomes and viral DNA before, this is the first time an entire eukaryotic chromosome with a clearly defined nucleus has been built from scratch.

BUILDING THE CHROMOSOME

The team painstakingly changed about 15% of the base pairs in the chromosome. They removed sections of repeated sections and 'junk DNA'—portions that have no purpose. They also removed 'jumping genes'—sections known to randomly move around and introduce mutations.

Boeke and his team were also able to insert their own

genetic sequences that would allow them to make future changes to the chromosome. One such addition would cut and rearrange or 'scramble' the DNA when exposed to the chemical hormone estradiol, making genetic modification easier.

"When you change the genome, you're gambling. One wrong change can kill the cell," says Boeke. "We have made over 50,000 changes to the DNA code in the chromosome and our yeast still live. That is remarkable. It shows that our synthetic chromosome is hardy, and it endows the yeast with new properties."

The researchers named the artificial chromosome SynIII and incorporated it into normal yeast cells. The yeast continued to grow, converting sugar into alcohol and reproducing.

Boeke wrote that the cells behaved almost identically to wild yeast cells with native chromosomes, saying, "only now they possess new capabilities and can do things that wild yeast cannot."

FUTURE APPLICATIONS

The scrambling process built into the chromosomes would allow researchers and scientists to precisely alter

the chromosomes and rapidly develop new strains with particular traits for use in drugs, vaccines and other biomedical products.

"With this technology, we can re-engineer and customize organisms. We could make much sleeker genomes for organisms that would be useful for making biofuels and other industrial applications," said Patrick Yizhi Cai, a member of the team at Edinburgh University.

VOCABULARY

- Biomedical
- Biofuel
- DNA
- Eukaryotic chromosome
- Nucleus

EXTENSION QUESTIONS

- What are some of the potential environmental or public health threats posed by synthetic or designer organisms?
- What would be the positive and negative outcomes if scientists could make the same breakthrough for human chromosomes?

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CONCUSSIONS IN AMERICAN FOOTBALL

By Samba Lampich

American football is the most popular sport in the United States. From the National Football League (NFL) to little league football, Americans love the sport. In 2013, the NFL generated a little more than \$9 billion in revenue and remains the most lucrative sports league in the world. What has remained largely an unspoken number is how many football players—from professional to those playing in little leagues—incur concussions. While sport-related concussions and their after-effects have caused debate, recent studies have begun to show how and why they are so dangerous.

POSSIBLE LONG-TERM EFFECTS OF CONCUSSIONS

Concussions have been proposed as a major cause of chronic traumatic encephalopathy (CTE), which is characterized by a loss of neurons and build-up of tau protein in the brain, and is often found in those with a history of head trauma. It's associated with memory loss, confusion and depression, and can be diagnosed only after death. Scans of living, retired NFL players found excessive tau protein in all of them, particularly in memory and emotion areas. The frequent suicides of retired NFL players have raised questions about whether CTE is caused by an underlying mental illness or if head injury causes both brain degeneration and mental illness. In a 2012 study, 34 out of 35 postmortem brain samples from former pro football players showed

signs of CTE. Six of the athletes had most likely died of suicide.

CHANGING THE GAME

The NFL has already enacted some changes to the game. These include a rule banning hits with the crown of the helmet, and putting independent neurological experts on sidelines during games who must clear a player before he can return to play. Also new is the rule that when a player loses his helmet, the play is immediately whistled dead.

CONCUSSIONS IN SPORTS

- CDC estimates reveal that 1.6 million to 3.8 million concussions occur each year
- 5-10% of athletes will experience a concussion in any given sport season
- Fewer than 10% of sport-related concussions involve a loss of consciousness (e.g., blacking out, seeing stars, etc.)
- Football is the most common sport with concussion risk for males (75% chance for concussion)
- Soccer is the most common sport with concussion risk for females (50% chance for concussion)
- 78% of concussions occur during games (as opposed to practices)

- Some studies suggest that females are twice as likely to sustain a concussion as males
- Headache (85%) and dizziness (70-80%) are most commonly reported symptoms immediately following concussions for injured athletes
- An estimated 47% of athletes do not report feeling any symptoms after a concussive blow
- A professional football player will receive an estimated 900 to 1500 blows to the head during a season
- Impact speed of a professional boxer's punch: 20mph
- Impact speed of a football player tackling a stationary player: 25mph
- Impact speed of a soccer ball being headed by a player: 70mph
- Head trauma resulting in brain injury is the greatest killer of people under the age of 45 and the greatest cause of disability in people under 44. Brain injury kills more children under age 20 than every other cause combined.

Source: Sports Concussion Institute®

VOCABULARY

- Concussion
- Trauma
- Chronic traumatic encephalopathy



THE PEN IS SMARTER THAN THE KEYBOARD

By Lisa Jancarik



A recent journal article in Psychological Science reports that taking class notes on a laptop instead of by hand may diminish a student's comprehension of the material. Lead author of the study, Princeton researcher Pam Mueller, says academic performance may suffer even when computers are being used as intended, rather than just for goofing off.

Mueller and her partner in the study, Daniel Oppenheimer (now at the UCLA School of Management), were inspired to perform this study by personal experience. Mueller recalled switching from using her laptop to pen and paper for note taking in her graduate studies.

"I felt like I'd gotten so much more out of the lecture that day," she said. The observation prompted Oppenheimer to mention a similar experience he'd had while using his laptop to diligently take notes during a meeting, until he realized he had no idea what the speaker was saying.

This conversation led to a study of 65 college students who were asked to watch one of five TED Talks on interesting topics that were not common knowledge. The students watched in small groups and were instructed to use their typical method of taking notes, using provided laptops without internet or paper. Following 30 minutes of distracter tasks, the students were quizzed on the lecture material. Questions were either recall or conceptual-application in nature.

Laptop users did just as well as paper note-takers on factual recall questions. However, they did demonstrably worse on conceptual questions (e.g., comparing or contrasting two ideas from the same lecture). A week

later, paper note-takers still outperformed their laptop counterparts when everyone was given an opportunity to review their notes.

Overall, students who took more notes performed better, but so did those with less verbatim transcription. In fact, simply having more notes isn't an advantage if the student has merely copied the lecture material verbatim as she hears it. Laptop users tended to transcribe, even when specifically instructed to avoid recording the lecture verbatim. This surprising finding suggests that the tendency to simply type mindlessly is difficult to overcome.

The researchers speculate that taking notes by hand may force students to process more information on the fly, leading to more efficient studying and better recall later.

VOCABULARY

- Transcribe
- Verbatim

COMPREHENSION QUESTIONS

- What do the authors suggest a student may not be doing (well) if he is taking notes on a laptop instead of by hand?
- This study does not appear to control for how well the students do on tests if they are using the same methods to take notes (i.e., everyone uses a laptop or everyone uses pen and paper). What do you think would happen if laptop users and paper note-takers were obliged to switch methods for a different part of the study?



LAKE TURNS BIRDS INTO STONE, THEN ART

By Mona Simpson

You're in northern Tanzania on the border with Kenya. It's 80 degrees out, it's dry, and you are aching for a drop of water. Before you stretches beautiful Lake Natron, over 420 square miles of water fed by springs and small rivers. Do you dive in? You shouldn't, at least not if you want to stay happy and healthy. Lake Natron is an alkaline lake with a salt marsh ecosystem. The waters have a pH of 10.5 and can burn the skin and eyes of animals that haven't adapted to the extreme conditions. Flamingoes and wetland birds use the serene lake as primary breeding grounds, taking refuge from predators. And lake inhabitants include tilapia as well as spirulina algae that turn the water red with their blooms.

A SPECIAL LAKE

The waters feeding Lake Natron carry sodium carbonate and other minerals into the lake, which has no outlet. Ol Doinyo Lengai, a million-year old volcano just south of the lake, feeds magmatic limestone into the waters via runoff. This volcano is the only one on the planet that spills natrocarbonatites. Sodium carbonate was used in Egyptian mummification, and its presence in the lake mummifies any animals who happen to die and fall into its waters. The alkalinity of the water pickles the bodies of the animals. The water is salty as well as alkaline and contains ash, which forms cement that coats the remains of the lake's inhabitants.

FROM DETRITUS TO ART

These 'stone' birds wash up onshore, particularly in the dry season, and now those birds are becoming art. Photographer Nick Brandt captured images of the birds that are sometimes eerie and always striking. His stark photographs of preserved birds from Lake Natron shows them posed as if they are still living. In Brandt's own words: "I took these creatures as I found them on the shoreline, and then placed them in 'living' positions, bringing them back to 'life,' as it were." Brandt's photographs are in a traveling exhibition and will ultimately be published in a photo anthology.



VOCABULARY

- Alkaline
- Detritus
- Natron
- Salt marsh

EXTENSION QUESTIONS

- What pH is seawater? Is it more alkaline or less alkaline than Lake Natron?
- How do algae blooms make the water red?

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substances. Most pharmacists work in pharmacies, though some work for hospitals or in research facilities.

Students interested in pharmacy should know that pharmacists are required to have a Doctor of Pharmacy in order to practice. The Pharm.D. degree may be pursued after a student begins his or her undergraduate college career. Students should begin in high school with courses in biology and chemistry. In college, advanced courses in biology, chemistry, and anatomy and physiology will all be necessary to gain admission to a Pharm.D. program.

Becoming a pharmacist is certainly a healthy career choice: the United States is expected to add 69,700 pharmacy positions – a job growth of 24% – from 2010 to 2020, according to the Bureau of Labor Statistics. The average pharmacist earns \$111,570 per year, which is much higher than the median pay in the United States.

Source: <http://www.bls.gov>

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KANGAROOS FARTS MIGHT SMELL OF SUCCESS

By Samba Lampich



There's nothing quite as off-putting as a pungent fart — be it from a beloved pet or mischievous sibling. And all that farting, burping and belching from cattle, sheep and other ruminants contain large amounts of methane, which is the most potent of the greenhouse gases (GHG). According to the Food and Agriculture Organization (FAO) of the United Nations, the total emission from global livestock is 7.1 Gigatonnes of CO₂ equivalent per year, which represents 14.5% of all anthropogenic GHG emissions (FAOSTAT, 2014).

Unlike other ruminants, kangaroo farts have been known to contain little methane — about 80% less than cows — but until recently the cause has never been fully understood.

SMIFFING OUT ANSWERS

Microbiologist Scott Godwin of Queensland Department of Agriculture, Fisheries and Forestry in Brisbane, Australia, and his colleagues investigated the microbes in kangaroos' digestive tracts and published their findings in the March 13 issue of *The ISME Journal*.

Godwin collected the microbes found in the foregut of three wild eastern gray kangaroos and let them ferment in bottles alongside cow gut microbes. When most animals digest food the microbes in their guts creates carbon dioxide and hydrogen. However, animals like cows and sheep have other microbes called methanogens that create methane.

The researchers found some methane-making microbes in the kangaroo samples, but they also found other active microbes such as acetogens. These special microbes take in carbon dioxide and hydrogen and produce acetate, which becomes a source of energy for the kangaroos. Researchers said it smelled “like manure with a bit of vinegar and parmesan cheese.”

Now that the research has yielded answers as to why kangaroos produce little methane, the ideal next step would be to find out if implanting kangaroo microbes, which included the acetogens, into livestock would reduce their methane production. This is turn would help reduce global warming.

VOCABULARY LIST/GLOSSARY

- Anthropogenic
- Acetate
- Acetogens
- Fermentation
- Foregut
- Greenhouse Gas (GHG)
- Methane
- Methanogens

FACTOIDS

- Scientists have developed a method for extracting methane from cow manure, cleaning and converting it into a biogas fuel that can be used as alternative energy to power the farm or sell.
- In 2012, U.S. greenhouse gas emissions totaled 6,526 million metric tons CO₂ Eq. (EPA, National Greenhouse Gas Emissions Data, 2014).

MEASLES CASES ON THE RISE IN THE US

By Samba Lampich

In late May, the Centers for Disease Control (CDC) released a report showing reported measles cases had reached a 20-year high. In the first five months of 2014, 288 measles cases were reported in 18 states. By comparison, at the end of 1994 there were 963 measles cases reported for the entire year.

This is not the kind of record we want to break, but it should be a wake-up call for travelers and for parents to make sure vaccination records are up to date," said Anne Schuchat, director of the CDC's National Center for Immunizations and Respiratory Diseases.

WHAT IS MEASLES?

Measles is a serious respiratory disease caused by a virus. It spreads easily through coughing and sneezing. In rare cases, it can be deadly. It starts with a fever that can get high followed by cough, runny nose, and red, watery eyes. A few days later, a red, blotchy rash starts on the face, then spreads to the rest of the body.

Measles can cause life-threatening pneumonia and brain inflammation, middle-ear infection, severe diarrhea and sometimes death.

People get measles disease by breathing in the measles virus, which is spread when an infected person coughs, sneezes or talks. It can be contracted by being in the same room as an infected person.

IMPORTING THE VIRUS

Schuchat said this year's outbreak was happening among unvaccinated people who contracted the infection abroad and were performing mission or healthcare work where they were in close contact with population at risk for measles. About half had travelled to the Philippines, which saw an outbreak beginning in October 2013.

Ohio had 138 confirmed cases, California had 60 and New York had 26. The Amish community in Ohio had the biggest outbreak where Amish missionaries brought the virus back from the Philippines. While Amish religious doctrine doesn't prohibit vaccination, many families do not get immunized. Medical research has shown that vaccinations are safe but there remains people who will not get their children vaccinated for religious, philosophical or other non-personal reasons.

The CDC is urging people who are not sure of their immunization status to get the Measles-Mumps-Rubella (MMR) vaccine. Ohio will be holding several clinics for people to get their vaccines.



VOCABULARY LIST/GLOSSARY

- Measles
- Mumps
- Vaccination
- Rubella

FACTOIDS

- Adults born before 1957 likely had the measles and should be immune.
- Measles is contagious from 4 days before until 4 days after the rash appears.

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SNAKES ON A SPACESHIP! SENDING 'SNAKEBOTS' TO EXPLORE MARS

By Samba Lampich

It sounds like a sequel to the movie *Snakes on a Plane*, but sending snakes to the red planet might not be a fictional plot.

RADIO SILENCE

NASA has landed four rovers on Mars, and these solar-powered robots have fixed wheels and robotic arms that limit their ability to traverse the Martian landscape and gather samples. Their fixed wheels and arms don't offer the flexibility to maneuver out of tight spots or wind through rough terrain easily. In 2009, Mars Rover *Spirit* got stuck in a patch of loose soil on the edge of a small crater, and in March 2010 it stopped communication with Earth. The European Space Agency (ESA) began thinking about alternative forms for robots that could explore other planets.

UNLEASHING THE 'SNAKEBOT'

Researchers at the SINTEF Research Institute in Norway and at the Norwegian University of Science and Technology came upon the ambitious idea to use slithering snake-like robots to explore Mars. Asket Transeth, a senior research scientist at SINTEF, and his colleagues are conducting a feasibility study to determine how such robots would perform on the red planet. The proposed snake robot wouldn't replace the rover, but augment it.

"One option is to make the robot into one of the vehicle's arms, with the ability to disconnect and reconnect itself, so that it can be lowered to the ground, where it can crawl about independently," Transeth explained in a press release.

The researchers believe that by combining the properties of a rover and the agility of a snake, the robot would create an ideal exploration dynamic. The rover would travel

long distances, examining samples, and the snake would detach and slither into inaccessible places like underneath rocks or in craters. And if the rover got stuck, the snake robot could conceivably be used to help pull it loose.



SINTEF researchers Pål Liljebäck and Aksel Transeth, and Knut Robert Fossum of NTNU's CIRIS, with Wheeko the snake robot

Using a snake robot would also change how samples are analyzed. Currently, soil samples are analyzed on the rover itself and the results communicated back to Earth. The snake robot could be constructed to collect samples and return them to Earth so that scientist could analyze them directly.

The ESA plans to send its own rover, *ExoMars*, in 2016 and 2018 while NASA is planning its own mission in 2020. It is possible that any of these rovers could rely on a snake robot.

EXTENSION QUESTIONS

- What are some other applications of snake-like robots here on Earth?
- What are some obstacles the 'snake robot' would encounter on Earth and other planets?

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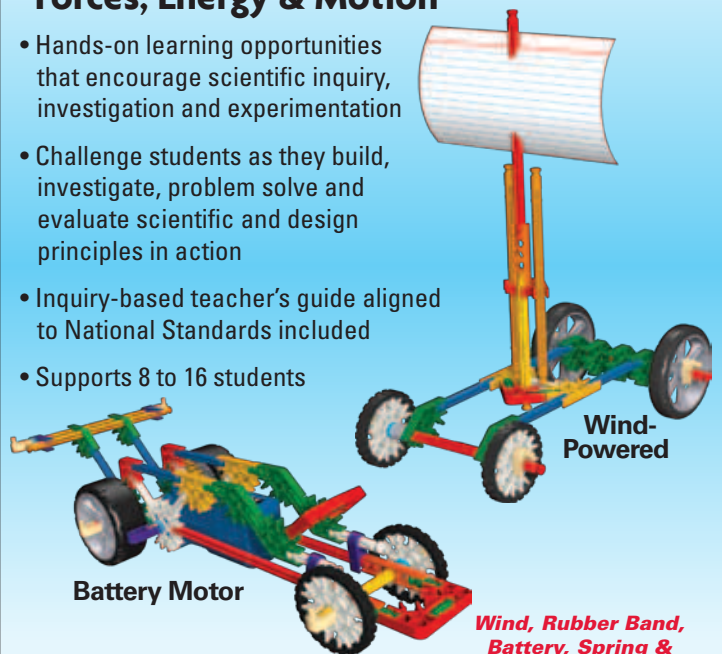
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CAN MENTAL PROBLEMS BE DIAGNOSED WITH A SCANNER?



Diagnosing mental disease usually involves lengthy evaluations by a psychiatrist who must determine if a patient's symptoms are a result of physical, mental or emotional issues, or any combination of the three. These evaluations can be invasive and rely on the honest responses of the patients.

SEEING INSIDE THE MIND

A paper published in the April 2014 issue of The Journal of Nervous and Mental Disease claims that mental health problems can be diagnosed using a device similar to Magnetic Resonance Imaging (MRI).

The authors of the paper, Zhang et al from Xi'an Mental Health Center in Shaanxi China, state: "The aim of this study was to evaluate reliability and psychiatric clinical value of quantum resonance spectrometer (QRS) in detection of affective disorders."

Zhang explains that QRS is similar to the MRI body scanner, but doesn't produce an image. Cells that make up the human body grow, form new cells and eventually die. When a cell regenerates it gives off a unique electromagnetic charge thanks to an imbalance of electrons. A sick cell will emit a different signal than a healthy cell, leading to the map of patterns associated with mental disease.

According to Zhang, QRS was able to identify and diagnose several psychiatric affective disorders, including symptoms of schizophrenia and mood disorders.

Zhang and his team claim positive results, sometimes better than 65%, of finding mental disorders, such as schizophrenia, several mood disorders and even irritability, in patients already diagnosed. If accurate, QRS has doctors eager to treat early signs of anxiety, depression and psychosis before they rule an individual's life.

EDITOR'S NOTE:

Zhang's paper has come under scrutiny because it doesn't appear to adhere to the author instructions of the JNMD. There are few precise descriptions of subjects, procedures, apparatus and methods of data analysis. This makes it difficult for other researchers to evaluate or replicate the study.

VOCABULARY

- Analysis
- Radio waves
- Magnetic Resonance

COMPREHENSION QUESTIONS

- How does the MRI work?
- What are some limitations to the use of MRI?

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Standard		2.0 to 9.0	100	S07769	24.10



NEW TICK-BORNE “HEARTLAND” VIRUS DISEASE EMERGES IN THE MIDWEST

By Samba Lampich



A new virus appears to be spreading in the central United States. Named the Heartland Virus, it has been identified in six people; five in Missouri in 2012 and one in Tennessee in 2013. It derives its name from the Heartland Regional Medical Center in St. Joseph, Missouri, where two local farmers were treated in 2009 for the first cases of the viral infection.

WHAT IS THE HEARTLAND DISEASE?

The Heartland virus belongs to a family of viruses called Phleboviruses. Most of them are passed through the bite of a mosquito, tick or sandfly. Studies conducted by the CDS show the Heartland virus is carried by Lone Star ticks which are found primarily in the southeastern and

eastern United States. Five of the six new cases reported tick bites in the days or weeks before they fell ill.

Patients diagnosed with the virus became sick in May to September. They all reported symptoms including fever, fatigue, diarrhea, loss of appetite, headache, nausea or muscle pain. In the confirmed cases, the patients all had low numbers of cells that fight infection and that help blood clot. After hospitalization, all but one patient fully recovered. The one that died had some other underlying health issues.

Nearly all of the newly reported cases were discovered through a study conducted by the Missouri Department of Health and Senior Services and CDC at six Missouri hospitals.

“During the past two years, CDC has worked closely with state health departments, hospitals and many experts from universities and other federal agencies to learn more about Heartland virus,” said Roger Nasci, Ph.D., chief of CDC’s Arboviral Diseases Branch. “By gathering information about the disease Heartland virus causes, and about how it’s spread to people, we hope to better understand the potential impact on the public’s health and how we can help protect people from this virus.”

There are some CDC-developed blood tests that can be used to confirm new cases of Heartland virus disease, and the organization is working to develop a diagnostic test that can be used by public health officials.

Because the disease is caused by a virus, it does not respond to antibiotics used to treat tick-borne bacterial infections such as Lyme disease.

AVOIDING THE HEARTLAND VIRUS

The CDC recommends that people follow these simple tips to avoid the Heartland:

- Avoid wooded and bushy areas with high grass and leaf litter
- Use insect repellent when outdoors
- Use products that contain permethrin on clothing
- Bathe or shower as soon as possible after coming indoors to more easily find and wash off ticks that are crawling on you
- Conduct a full-body tick check after spending time outdoors
- Examine gear and pets, as ticks can “ride” into the home and attach to a person later

SICK HONEY BEES BUZZ AWAY FROM THEIR HIVES

By Lisa Jancairik

Research from the French National Institute for Agricultural Research suggests that honey bees (*Apis mellifera*) infected with pathogens leave the hive permanently, limiting the spread of infection. Scientists in Avignon infected honey bees with either of two known parasites, *Varroa destructor* (a mite) and *Nosema ceranae* (a fungus) and observed their behavior and the behavior of other bees in the hive.

Bees with the parasites on board showed changes in which genes were active in the bees' brains. The up-regulated genes (genes that were switched on or made more active) involved foraging and neural function, among other things. Infection also altered the "family scent" by which honey bees from the same hive recognize each other.

SELF-EXILE FROM THE HIVE

Curiously, uninfected honey bees do not treat the infected bees differently in spite of the change in "family scent". Social interactions like grooming and antennal contact continued as usual, and the sick bees were not expelled from the hive. Instead, study leader Cynthia McDonnell hypothesizes that the honey bees infected with these parasites leave the hive voluntarily, possibly as a result of the changes in the bees' brain chemistry. She went on to suggest that voluntarily leaving the hive may be a response to other parasitic infections, too, because the two parasites studied were very different.

University of North Carolina bee researcher Olav Rueppell commented on the study to NBC News, saying that this study does not explain the widely reported problem of declining honey bee population. His team's own earlier research predicted her findings, when they simulated infection using carbon dioxide to make bees feel sick. He also takes McDonnell's conclusion that the behavior of leaving the nest to limit contagion spread as speculative. The overlap in expression of genes in the bees' brains that McDonnell views as significant strikes him as a "small amount of neurogenomic overlap".



VOCABULARY

- Parasite
- Up-regulated

COMPREHENSION QUESTIONS

- Why does Dr. McDonnell think that honey bees may abandon the hive as a response to infection generally, not just infection with the two parasites her team studied?
- This behavior by infected bees from the hive has been described as "altruistic". Do you agree with that characterization? Why or why not?

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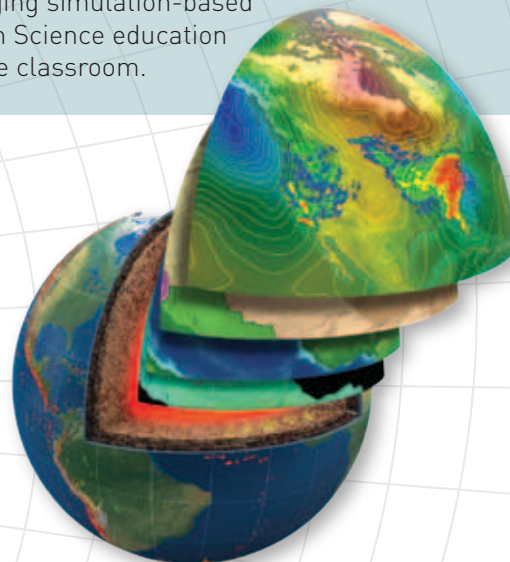
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GLOW-IN-THE-DARK ROAD DEBUTS IN THE NETHERLANDS

By Samba Lampich



Melanie Schultz van Haegen, Dutch Minister for Infrastructure and The Environment, inspects Smart Highway.

The Netherlands is unveiling and testing a unique plan to save electricity by eliminating street lights, but still lighting a motorist's way home. Dutch engineers unveiled glow-in-the-dark road markings along a 500-meter (0.3 mile) stretch of the N329 in Oss, a town about 100km south east of Amsterdam.

The road markings are made using paint that contains a photo-luminizing powder absorbs daylight and slowly releases a green glow for about eight hours at night.

The idea was the brainchild of interactive artist Daan Roosegaarde, who teamed up with the Dutch civil engineer firm Heijmans.

Last year, Roosegaard told the BBC that: "The government is shutting down streetlights at night to save money. Energy is becoming much more important than we could have imagined 50 years ago. This road is about safety and envisioning a more self-sustainable and more interactive world."

THE GLOW BEGINS TO FADE

The pilot program was launched in early April 2014, but two weeks later the paint was beginning to fade due to moisture from rainfall.

In a statement released by Heijmans, the firm said: "As expected, the 'real life' trial enables us to learn from the environment and users, like humidity and user experience. We will use these insights to introduce

an update to the Glowing Lines 2.0 version. In the meantime, we have temporarily faded out the lining to prevent any confusing situations for road users."

FUTURE PLANS

The firm is planning to launch a larger scale, second version of the glowing lanes this summer.

The team had also initially planned to develop special weather symbols that would appear on the road when the temperature dropped to a certain level. The special paint would reveal a giant snow flake-shaped symbol on the road to alert drivers that conditions were icy. However, that special symbol phase has not yet been launched.

Countries like the United Kingdom are watching the trials in the Netherlands, but have no immediate plans to implement similar road markings.

EXTENSION QUESTIONS

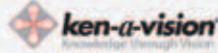
- What are some other limitations to glow-in-the-dark highways? What are some advantages?
- What are some ways highways and roads could be made 'smarter'?

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USING PIG POOP TO CREATE ENERGY

By Celeste Beley

Pig farms have a smelly reputation. From the ammonia and methane to the pathogens they produce, they've never been known as a pleasant place, but one farm in North Carolina is changing that. North Carolina law now mandates that some of its renewable energy be derived from chicken or swine waste, and The Loyd Ray Farm is the first to turn pig waste into energy. Partnering with Duke University, Duke Energy and Google (who provided initial investments as part of their corporate commitment to reduce their carbon footprint to zero), they converted a standard hog farm into a sustainable farm using a system designed by Cavanaugh Solutions.

The farm flushes 80,000 gallons of manure daily into a biodegester — basically a 174-by-218 plastic domed pit. Anaerobic bacteria convert the organic waste into methane, carbon dioxide and other chemical byproducts. The biodegester mixes liquid to keep the bacteria digesting at maximum efficiency, and also reduces pathogens without using synthetic chemicals. The gas that is harnessed generates enough electricity to run the entire waste treatment system plus lights and machinery for five of nine hog barns. Excess gas is burned to convert methane into carbon dioxide. Leftover liquid waste is then aerated, creating nitrate from the ammonia, and is used for flushing out the barns or as irrigation in the fields. As a bonus, the plants absorb the mixture faster since plants absorb nitrates more easily than ammonia. This results in less fume and odor emissions from the farm, something the Loyd Ray Farm neighbors were happy about and quick to note!

Estimates show that the new process prevents the emissions of approximately 5000 metric tons of carbon dioxide per year — the equivalent of taking 1000 cars off the road. The system is still developing and changing due to weather and environmental changes, but the lesson is clear: electricity generated from swine waste is a competitor in the renewable energy market. Duke University is hopeful that other farmers will follow suit.

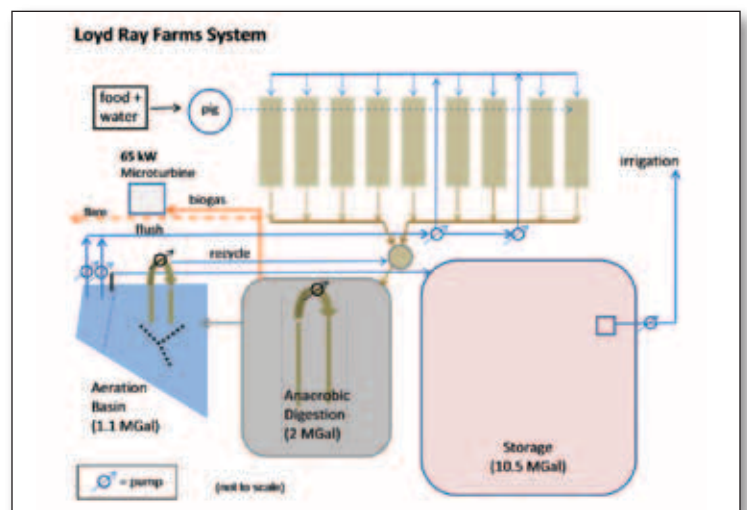


Diagram of the Innovative System at Loyd Ray Farms

VOCABULARY

- Pathogen
- Anaerobic
- Nitrates
- Renewable
- Sustainable
- Aerate
- Carbon Footprint

EXTENSION QUESTIONS

- Could other animal waste be used to create renewable energy? What types and why or why not?
- What are the advantages and disadvantages of using animal waste for energy?

Credit: Marc Desfrusses, Duke University



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HARVESTING FOG GETS WATER TO THE DRIEST REGION

By Mona Simpson

Water scarcity affects around 1.2 billion people in the world. But did you know that it is possible to harvest drinking water from clouds? With fog harvesters, fog could be a huge source of potable water for people in arid climates.

Just like water condenses on the outside of a drinking glass, scientists can condense water from fog clouds onto a fine woven mesh that looks like and uses the same material as the strings of a tennis racket.

These current-style harvesters can capture 2% of the water available in a mild fog. But by tweaking the makeup and design of the mesh, researchers have discovered how to get as much as 10% of the water from clouds.

Researchers in Chile worked together with researchers at Massachusetts Institute of Technology (MIT) to discover a way to deliver up to 5 times the water that existing systems provide. They did this by optimizing the design of the mesh structures that harvest fog. This included 1) using metal fibers instead of plastic fibers, 2) determining the perfect size of holes between the fibers, and 3) finding the best coating to apply to the mesh to cause the water to coalesce and drop down into collection containers.

The systems were tested in an arid region of Chile that includes the Atacama Desert, where there is negligible rainfall (0.004 inches of rain per year), but a strong coastal fog called camanchaca. This area is considered the driest place in the world. A few square meters of the current mesh technology produces a few liters of water per day. Using new meshes like the ones designed by the researchers, the expected yield could blossom to as many as 12 liters per day.

The researchers found that the best mesh was made of stainless-steel filaments as wide as four human hairs, particularly when they were spaced twice that distance apart.

A practical use of this technology is to deliver drinking water to people who otherwise would not have it, such as in deserts or drought-stricken areas. The technology has proven to be effective. People in at least 17 countries use the technology in its current state.

VOCABULARY

- Arid
- Negligible
- Camanchaca
- Potable



MIT Chemical Engineering major Maria Tou conducts fog harvesting research in Chile

Credit: MIT International Science and Technology Initiatives

EXTENSION QUESTIONS

- How does the amount of rain in the Atacama Desert compare with the rainfall where you live?
- How many liters of water does a person need per day?
- How many water harvesters would you need to provide enough water for your classroom daily?

IS HEATING UP YOUR WORKOUT BENEFICIAL?

By Lisa Jancairik

Maybe you've heard that you can get a better workout in hot weather, or you've seen people out for a run in a thermal suit. Maybe the wrestling team dons extra clothes during conditioning season. Is there any benefit to working out in warmer temperatures?

Not really, according to exercise physiologist Daniel Zeman, although it is true that it takes less time for your muscles to warm up in spring-like temperatures of 50s, 60s and 70s (Fahrenheit). However, colder temperatures can improve athletic performance by reducing the risk of heat stress and dehydration.

That said, the best benefit of working out during warmer weather is that you might feel like doing it in the first place. Zeman comments that spring makes mammals naturally want to be more active, so humans are more inclined to go outside and exercise.

As a footnote, going out for a workout in the spring can also boost one's vitamin D level, although it doesn't take much sun exposure to do it. Athletes take note: skeletal muscle has receptors for vitamin D, and the vitamin has long been thought to improve athletic performance. Still, sunscreen needs to be a part of the equipment for any outdoor exercise regimen.



VOCABULARY

- Heat stress
- Dehydration

EXTENSION QUESTIONS

- When do you like to be active outside? Do you think warmer weather has an impact on your desire to work out?
- What is the main benefit of working out in cooler weather instead?

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PROTECTING YOUR SKIN FROM THE SUN

By Christa Cuccia



Some sunscreen lotions have only been designed to protect against UV B rays, which is the main cause of sunburn, instead of the added protection against UV A rays associated with aging and skin damage.

Dr. Steven Q Wang, director of dermatologic surgery and dermatology at Memorial Sloan-Kettering Cancer Center in Basking Ridge, N.J., and a spokesman for the Skin Cancer Foundation, says, "Sunscreen is not a magic bullet." He also states that, "It's just one of the defenses against the harmful effect of UV radiation, and that message gets lost."

PROTECTING YOURSELF

One way to take precautionary action is to limit your time in the sun; midday is when the rays are the strongest. Wearing hats, shirts and cover-ups also protects the skin as does sitting under a shade or umbrella. Relying exclusively on sunscreen for protection is not enough.

READ THE LABELS

It's also advised to check the ingredients of the sunscreen. Use of the label is key to understanding what protection is offered.

VOCABULARY

- Ultraviolet Radiation
- Ultraviolet B (UV B)
- Ultraviolet A (UV A)
- Sun Protector Factor (SPF)

Words like "broad spectrum protection" mean the sunscreen has been proved to protect against both UVA and UVB rays, although the UVA protection may be comparatively weaker. UVA protection should be at least 1/3 of the UVB protection.

A higher SPF doesn't mean greater protection. High SPF sunscreens usually offer far greater UVB than UVA protection, thus offering a false sense of full protection. The FDA is reevaluating sunscreens with SPF's that exceed 50 because it is not clear that they are actually more effective

The FDA considers a product "water-resistant" if it maintains its SPF level after 40 minutes of water exposure. A product is considered "waterproof" if it maintains its SPF level following 80 minutes of exposure to water. Those who spend long periods of time in the water should use waterproof sunscreen.

FACTOIDS

- The sun is most powerful from 10 a.m. to 2 p.m.
- A bad sunburn as a child doubles your risk for melanoma later in life
- Avoid sunscreen sprays; not enough sunscreen makes it to the skin
- Purchase fragrance-free products. Scents bring more unnecessary chemicals and potential allergens to the mix

Skin Cancer is the most common kind of cancer in the United States, with the number of cases growing each year. Even with sunscreen sales approaching \$1 billion a year, melanoma diagnoses have risen 2% a year since 2000.

Experts are blaming this rise on the improper use of sunscreen. They say people are not applying enough lotion and not reapplying every two hours as instructed.

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NewPath Learning offers districts, teachers, and students an online headquarters for education. This Web-based program is a one-stop shop for teachers looking for ready-made lessons that can be tweaked to meet classroom needs or resources to help students broaden their understanding. The website functions in three major ways: as an interactive gradebook that tracks student progress, as a lesson plan builder, and as a repository of educational videos, activities, and interactive tools, such as virtual labs. In addition to life sciences, the online learning program also offers resources for physics, chemistry, and other sciences.



Teachers who log into the site can use the digital gradebook — a significant component of the program. By adding classes and students, teachers can easily share a variety of well-organized, interactive tools and assignments, including quizzes, worksheets, games, virtual labs, and self-contained multimedia lesson plans. Students create safe, simple profiles and log in to access classroom content. A basic, easy-to-use digital calendar keeps students organized, reminding them of assignment due dates and providing links to content. The program assesses quizzes and activities, reducing the amount of grading time. The gradebook also

keeps track of student work that has been completed. Students receive immediate feedback, so it's easy to check on their progress.

This online learning suite allows teachers to build lessons either by using the large content repository on the website or by uploading additional material. Teachers can share lessons with students or the entire community of educators using the NewPath Learning program. All materials are Web-based and accessible from any computer or device — Internet connection

required! Content cannot be downloaded, but everything is printable. Resources meet the demands of various state standards, including those of Florida, New York, and Texas. The content has also been vetted by classroom educators.

The resources offered by NewPath Learning are not intended as teacher-replacements. As a caveat, some of the multimedia lessons and interactive assignments, particularly in life sciences, lack engagement. Students sit and listen to a recorded lecture and view slides.

Quizzes gauge lower-level thinking skills, like recall and comprehension. But, with teacher input, these activities can supplement the learning taking place in the classroom.

Interested teachers can log in free using a limited 30-day free trial. Subscriptions start at \$199.95 per year per teacher for a maximum of 150 students. NewPath Learning provides a list of grants and funding sources that can contribute to the purchase of a subscription.

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