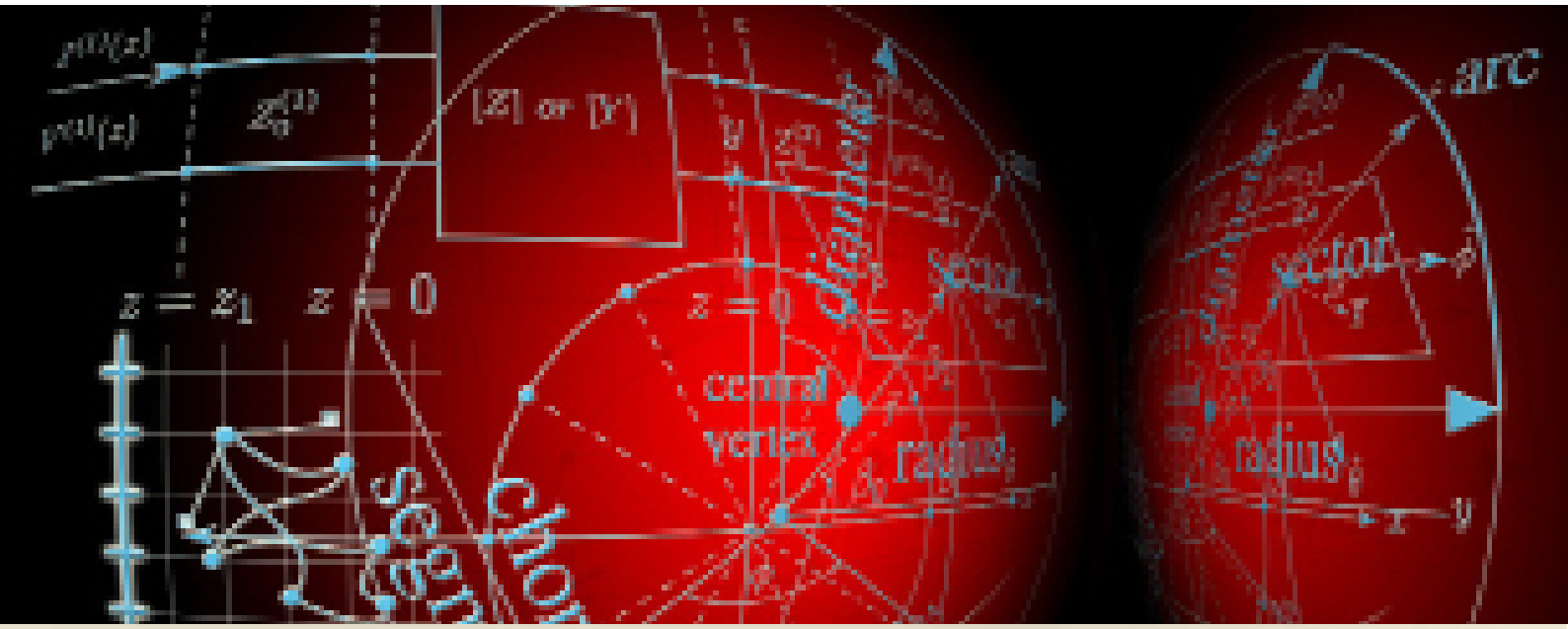
Pioneer® academics magazine



Rahil Bathwal:

How a Pioneer Alumnus is Solving Mumbai's Waste Crisis and Taking His Creativity to Cal Tech

March 2017, Issue 3

Pioneer® academics magazine

Table of Contents

Pioneer Academics Magazine, March 2017, Issue 3

www.pioneeracademics.com
Pioneer Academics, 37 Mandrake Rd., Monroe Township, NJ 08831, USA
Phone: 1-855-572-8863 (Toll Free, 9am-9pm ET)
info@pioneeracademics.com

Pioneer NEWS

Research Students Ecstatic About Being Published in the 2016 Pioneer Research Journal

Monroe Township, N.J., March 15, 2017 – Today seventeen teenage researchers saw their names in print for the first time and received a personal copy of the The Pioneer Research Journal, 2016, Vol. 3, an international collection of undergraduate-level university research conducted by high school students who recently completed Pioneer Academics' Pioneer Research Program. The scholars' responses were both ecstatic and edifying.

Isaac Ick, a student at Dobyns-Bennett High School in Kingsport, TN, was fascinated by computational quantum chemistry. Hetitled his research project, Molecular Transistors: The Effects of Test Molecules on the Conduction Patterns of a Lithium Nanowire.

"My research showed that the quantum lithium nanowire devices I designed function similarly to a classical transistor," says Ick.

"It feels amazing to conduct a meaningful investigation into the design of a quantum semiconducting device. Hopefully, more research will be done to make these devices a reality," Ick exclaims.

Pioneer Research Program students work one-on-one with U.S. university professors, engage in advanced study, and research a topic in which they are interested, culminating in a full-length research paper. Among the 225 papers produced in 2016, 45 papers were nominated. The ten-week, after-school program is conducted entirely online, allowing high school students from all over the world to participate.

Rahil Bathwal lives in Mumbai, India. He is a student at Jamnabai Narsee International School. His mentor was a professor of mathematics at Hamilton College, Clinton, NY. Bathwall Developed a mathematical model for determining the optimal location for city landfills.

"I've always enjoyed mathematics. This unique opportunity to research real-world applications in this field has been very rewarding and has taught me various mathematical and research skills. It's an honor to know that I will be published, which has motivated me to further contribute to the mathematical community," says Bathwal.

The best research papers are chosen for publication in The Pioneer Research Journal by a committee of 26 college professors. The Journal's chief editor is Timothy Elgren, Ph.D., Dean of the College of Arts and Sciences, Oberlin College, Oberlin, OH.

"Pioneer Research Program students are empowered to rise above traditional academic limitations to make their mark in 24 diverse fields. This Journal represents the top 8% of the program's most impactful projects in disciplines ranging from neuroscience, chemistry, and mathematics, to film studies, architecture, and economics," says Elgren.

The Pioneer Research Journal, 2016, Vol. 3, is posted on the Pioneer Academics website.

Pioneer NEWS

Contributing Authors to the Pioneer Research Journal 2016, Vol. 3

Joshua E. Roth
Northside College Preparatory High School
Chicago, Illinois, United States
Culture and Pain: The Effect of Culture on the Production of Endorphins in the Brain

Rahil Bathwal
Jamnabai Narsee International School
Mumbai, India Jamnabai Narsee
Locating Obnoxious Facilities: Minimizing Risk and Cost of Disposing and Transporting Hazardous Waste

Xi Yue
The Affiliated High School of South China
Normal University – Guangzhou, China
High-Rise Organicity: A Proposal for a Bamboo-Themed Skyscraper

Isaac Ick
Dobyns-Bennett High School
Kingsport, Tennessee, United States
Molecular Transistors: The Effects of Test Molecules on the Conduction Patterns of a Lithium Nanowire

Tongxin Zhang
WHBC of Wuhan Foreign Languages School
Wuhan, China
How Effective is Fiscal Policy in Correcting Income Inequality?

Pranav Bharat Khemka
Jamnabai Narsee International School
Mumbai, India
Study of Neural Circuits Involved in the Intuitive Decision Making Process in Teleostei

Lu Zeng
Shenzhen Foreign Languages School
Shenzhen, China
From the Dark Knight to Francis Underwood: Twenty-first Century Noir Heroes

Chen Zhou
Jiaxiang Foreign Languages School attached to
Chengdu No.7 Middle School
Chengdu, China
Impact of School Facilities on the Quality of Senior High School Education in China: A Quantitative Study

Ria Tomar
Mission San Jose High School
Fremont, California, United States
The Neural and Cognitive Basis of Dreaming

Yuchen Xu
The High School attached to Renmin University of China
Beijing, China
A World of Possibility: Tier-Oriented Base-Storage Network for CCN Routing

Alesha Wong Yun Ying
Tenby International School
Setia Eco Park, Malaysia
Comparing and Contrasting Economic Development: The Case of Malaysia and Singapore

Yutong Huang
The Affiliated High School of South China Normal University
Guangzhou, China
The Silver Lining Behind the Darkness: Social Media as an Innovative Tool to Combat Sex Trafficking in Southeast Asia

Kevin Li
Naperville North High School
Naperville, Illinois, United States
The Market Efficiency of *Smart Money* During the Tech Bubble

Zijun Zhang
Experimental High School Attached to Beijing Normal University
Beijing, China
Characterization of Chitosan/PVA Scaffolds with Chitosans of Different Average Molecular Weights for Tissue Engineering

Sean Hu
Pacific American School
Hsinchu City, Taiwan
Athena's Spoiled Olives – How Institutional Flaws of the European Union and Greek Politics Shaped a Failing Economy

Yibing Du
The High School Affiliated to Renmin University of China
Beijing, China
East European Jewish Children's Health Conditions on the Lower East Side, New York City, 1890-1914

Cheng XU
WHBC of Wuhan Foreign Languages School
Wuhan, China
Potential for Developers and Investors in Diabetes Apps to Profit by Improving the Chinese Healthcare Industry

How a Pioneer Alumnus is Solving Mumbai's Waste Crisis and Taking His Creativity to Cal Tech

Rahil Bathwal

Pioneer Research Journal 2016 published author who will be attending Cal Tech in Fall 2017

Mumbai is one of the most populous cities in the world. It is India's richest city and the cradle of Bollywood. But underneath its energy and glamor, there is a dark secret lurking, and it's not the slums that were immortalized in the 2008 hit movie Slumdog Millionaire. It is the largest and the oldest dumpsite in Asia – Deonar.

Mumbai's silent killer, Deonar receives half of the 11,000 metric tons of trash produced by Mumbaiites every day. The pile of refuse has already reached the height of an 18-story building and has started to seriously threaten the health of nearby tenants. This year the dumpsite caught fire several times, one fire so large NASA reported it was visible from space. The crisis has sparked fear of respiratory and contagious diseases, but the dumpsite is now so huge that a fast solution seems out of reach.

"The amount of pride that I feel after having done the program – this is something that surprised me."

And while the local government is scrambling to find an answer, citizens are experiencing a new environmental awakening about the trash disposal problem. Some of them are petitioning, others are staging marches, and some are even going on hunger strikes. But one of them, local high school student and Pioneer alumni Rahil Bathwal, is using math!

"The waste management problems I've seen in my city are quite drastic, and I wanted to develop something which could be implemented in the future, something I could further once I go to college," Rahil said.

Rahil was one of three students from India who received an opportunity to participate in the Pioneer Research Program. Through the program, he studied graph theory with Professor from the Department of Mathematics at Hamilton College.

Graph theory, in its simplest definition, is the mathematical study of networks of nodes and their connections. The topic he explored for his Pioneer research project was mathematical models that could provide blueprints for building facilities that people want nearby – such as emergency services – and facilities that people want as far away as possible – such as nuclear reactors and landfills.

Rahil's research focused on creating a model for locating so-called obnoxious facilities in the Indian state of Maharashtra. He then decided to offer his own solutions for the mounting pile of trash inside his city.

Air pollution has become one of Mumbai's pressing issues. (Photo: Vijay Sonar)

"Since I live in Mumbai where the problem of waste management is extremely severe, I thought of approaching the municipal authorities so that I could present my work and try to take it towards practical implementation."

The engineers at the city's main office took an interest in his work and gave him advice on further implementing the project.

"This has helped me understand real-world problem-solving, and it's an extension of the theoretical math I did in my research," said Rahil. "Mumbai is a really large city, and it's actually an island city, so the problem of landfills is a lot more complicated. As of now, the mathematical model I created can be extremely useful, but there are several non-mathematical factors that need to be considered, like government regulations and water bodies around Mumbai. Once I can develop my model to incorporate such factors it will definitely be something that can be considered."

Rahil said that the whole experience made him a lot more confident. **The Pioneer program he was involved in was a lot more advanced than the usual high-school syllabus. The opportunity not only gave him a chance to use technology that can actually solve problems in facility location but to learn how to develop his ideas and arguments into a coherent college-level paper.**

The relationship with his mentor also taught him a lesson about the value of interaction, and this turned out to be a paramount aspect of his Pioneer experience.

"I am a lot more sure about the answer I'm giving even though I am not sure if it's correct. I am sure that if I contribute, even if it's wrong, I will be able to learn a lot more."

His Pioneer mentor wasn't the only source of knowledge for Rahil; his peers helped him through the process of discovering and reaching new mathematical solutions.

"In the Pioneer group sessions, there was so much that we were able to learn from each other; they all had an incredible passion for math, " said Rahil. "In school, I don't often find a group of friends that like math, but here was a group of people who were so excited about the subject that they decided to do something beyond high school."

Rahil also stated that he was surprised at how much he enjoyed the whole experience of diving into real scientific research.

˝When I started Pioneer, I thought the best part would be learning about different mathematical topics, but at the end of the program, I think the best part was writing the paper – something that I can show people and say – 'This is my work.' The amount of pride that I feel after having done the program – this is something that surprised me.˝

The experience has motivated him to pursue his interests after high school. Rahil has been accepted to California Institute of Technology and he is excited to bring that creativity there.

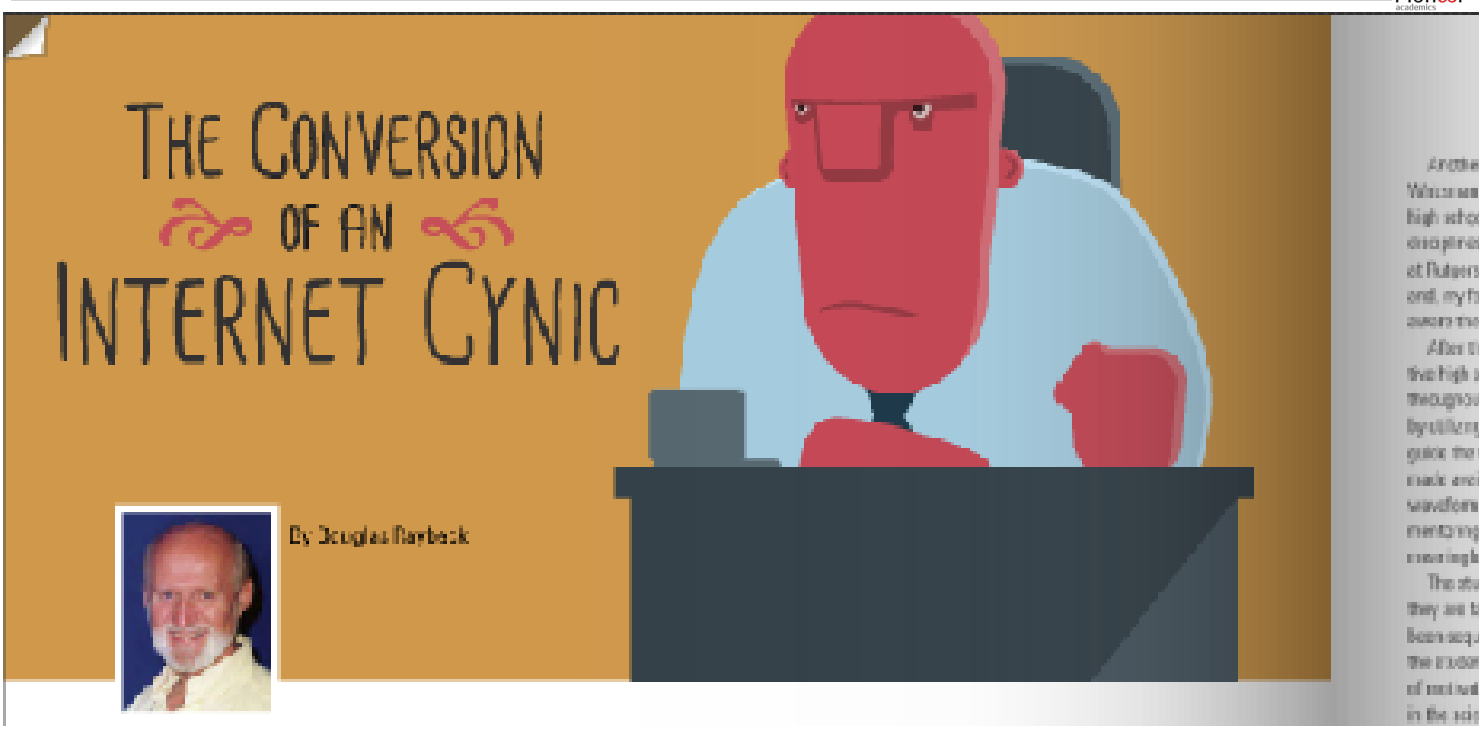
"Since Pioneer, I realized that research was something that I really want to do. The research option became an important criterion for me as I narrowed my college list. I think Pioneer has helped me understand what I want to do in college and also given me a topic I would like to pursue later."

Looking at the future, passionate young scientists like Rahil are sure to be in high demand in his native India. The amount of trash generated by an average resident of Mumbai has doubled in the past three decades. The city of 18.4 million people is running out of space for its waste.

But the issue stretches well beyond the state of Maharashtra. Today more than 350 million Indians live in urban areas, and by 2030 this number will probably rise to 650 million. At the same time, only 23 percent of urban solid waste is processed.

With its current economic development and rising standards, India can expect new challenges ahead. The environment is already receiving tremendous impact, prompting citizens to advocate lower consumption, recycling, and in Rahil's case – creating new solutions with science.

"I like mathematics because it's a lot more objective. I can try to find a solution in a more definite way. Sometimes I feel that maths isn't just about finding an answer; it's about finding a new approach or method, and that allows me to express creativity in a more unconventional way."



The Conversion of An Internet Cynic

Douglas Raybeck

From *The Journal of College Admission* ,winter 2016

For education to really occur, as opposed to the simple transmission of information, there must be interaction between the educator and student, and between student and student. It is this interaction that creates a synergistic effect in which the classroom is more than the sum of its parts.

Early MOOCs (Massive Open Online Courses—with an emphasis on massive) usually featured very talented and articulate lectures conveying information in a well-organized and effective fashion. However, from my perspective, there was little or no opportunity for the recipient of the information and wisdom to interact with the provider. This observation quickly let to my cynicism concerning the effectiveness of online education. It struck me as a watery pea soup, containing some intellectual nourishment, but little real sustenance, even with the presence of some occasional ham.

However, in the last three years I have encountered quite a different model for online education that has greatly altered my position. Online programs such as the independent Pioneer Research Program and Waksman Student Scholars Program offered by Rutgers University (NJ) feature small classes, opportunities for individual mentoring, and the freedom/obligation for students to conduct research projects of considerable scope and merit while still in high school. The intimate nature of these programs allows faculty to assess a student's capabilities and suitability for colleges and universities. In turn, this suggests the potential for online collaboration between high schools and universities to improve student preparation for higher education, as well as to gauge what sort of higher education institution is most appropriate for a student.

I have long believed that the development of critical thinking skills requires students to take intellectual risks in situations where they may be uncertain of the correct answers. It also means they must make mistakes. Developing the realization that making mistakes is an important component of education, and that it promotes the development of critical thinking, pushes the students toward further risk-taking and the development of better skills. The Pioneer Program, in which I currently teach, provides opportunities for just this kind of education. Candidly, I don't know how the Pioneer Research locates the students I teach. But they are among the brightest and most motivated I have encountered in my nearly 40 years at Hamilton College (NY), one of the more selective institutions in the country. Last year my students were drawn from China, South Korea, and Washington, DC. Other program participants hailed from Brazil, Rwanda, Afghanistan, Philippines, Turkey, Spain, Malaysia, and India. Obviously, the increasing amount of cross-cultural exposure can only add to the breadth of student experiences.

In addition to participating in my class, doing assigned readings, and executing a modest number of assignments, each student must construct and execute a significant independent research project culminating in a 15- to 30-page paper, with supporting data. I am a psychological anthropologist who speaks four languages and has published on psycholinguistics. As a consequence, I can appreciate and be impressed by the English skills of foreign students working in a second language. More striking still is the

quality of the final research projects. My institution requires a senior project prior to graduation and many of the Pioneer research projects I have encountered (from high school students!) would serve nicely in fulfillment of that requirement.

I and many other educators believe independent research is the apex of education. The process of education is not unlike watching a robin raise its young. Initially, the mother robin shows up with worms of information and the young raise their beaks skyward, their maws wide. (Admittedly, most students are not this eager to acquire information, but no metaphor is perfect.) As the robins grow in size and capability, the adults begin to educate them in the matter of flight. These nestlings have rudimentary skills and are still bound to the confines of the nest (aka classroom). As the process progresses, the adults encourage the young to experiment with very brief flights, akin to small, course-specific research projects. Finally, when the fledglings are sufficiently mature and capable of flight they are encouraged or even forced to leave the nest. In comparison, a truly independent research project is considered evidence of sufficient ability and mastery to serve as a capstone of the educational enterprise.

Another excellent online educational opportunity is provided by the Waksman Student Scholars Program. This science-oriented initiative engages high school students and their teachers in molecular biology and allied disciplines. Students spend an initial three-week summer session in the labs at Rutgers where they learn such arcana as how to sequences the DNA of viri and, my favorite, analyze the jumping genes in Drosophilia. (I wasn't even aware the little buggers had specialized genes for jumping.)

After that experience, students and their teachers return to their respective high schools where they continue to pursue the initial research subject throughout the academic year. This is where remote education enters and, by utilizing tools, such as Skype, Rutgers scientists continue to mentor and guide the work of students. In addition, Rutgers has either developed and/or made available a series of online educational tools including a DNA sequence waveform reader. (No, I don't know what that is either.) However, remote mentoring and easy access to scientific tools mean that students can continue meaningful research at their own high schools.

The students are not engaged in "make work" research. On the contrary, they are tasked with original research, often sequencing a virus that has not been sequenced before. In such cases, the result is frequently published with the student listed as a co-author. This impresses me as an excellent means of motivating students and addressing the dearth of young people interested in the sciences.

The Waksman program has been in operation since 1993 and many former participants have gone on to careers in the sciences, a very desirable outcome. Counselors should encourage college-bound teens to seek opportunities for similar online learning programs where they can conduct independent research and experience the associated risks. The intensive mentoring involved in independent research projects yields yet another benefit. The instructor gains a good sense of the individual student and his or her level of initiative, intellectual curiosity and academic capability. Admission officers should seek out students who have participated in such programs, and, when possible, work with faculty members to determine an individual's fitness for admission. Such feedback could be especially useful for admission officers trying to ascertain the college-readiness of international students.

My original cynicism concerning the suitability of the Internet for meaningful education was based on my impressions of initial online efforts. However, I have to observe it is no longer "your father's Internet." Advances in communication software have made genuine interaction possible between educator and students, and between student and student. Images and even videos can be displayed to the class, questions asked, and responses obtained immediately. Advances in educational websites have greatly increased the transparency and accessibility of the software for both students and faculty. I can't write a single line of code, but I find it simple to maneuver among the programs with which I am presented, and to accomplish fairly complex educational objectives.

It is becoming increasingly possible for college applicants to have completed independent research projects of significant quality. It is the rewarding interactions with students, and the quality of their research projects that has changed this former Internet cynic to an enthusiast.

Dr. Douglas Raybeck

Dr. Douglas Raybeck is Professor Emeritus of Anthropology at Hamilton College. He received his Ph.D. in Anthropology from Cornell University in 1975. He has published more than 60 papers and six books, four of which were co-authored. He has mentored students in the Pioneer Research Program for more than three years, and is one of the program's most popular professers.

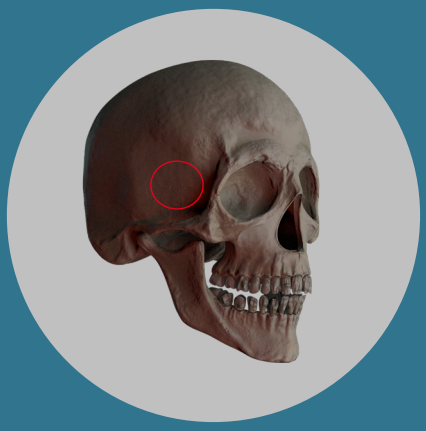
Did you know?

People with blue eyes are all descended from one ancestor. Originaly all people had brown eyes. The mutation that led to blue eyes occurred between 6,000 and 10,000 years ago and affected the a gene involved in the production of melanin, the pigment that gives color to our hair, eyes and skin. It's estimated that approximately 8% of the world's population has blue eyes.

Ravens can mimic human speech much like parrots. Ravens also mimic other sounds, like car engines, toilets, and different animals. They are considered to be one of the smartest animals in the world and have been known to imitate wolves or foxes to attract them to carcasses that they cannot open.

Pearls melt in vinegar. Pearls are made up from calcium carbonate which reacts with vinegar (acetic acid) to give calcium acetate, carbon dioxide and water. According to Roman-time rumours, Egypt's famous ruler Cleopatra drank a cocktail with a dissolved pearl to win a wager with Mark Anthony to create the costliest catering bill ever.

The world's largest cave is Hang Son Doong in Vietnam. It has its own climate, jungles, clouds and rivers inside. The cave runs for approximately 9 kilometres (5.6 mi) and contains some of the tallest known stalagmites in the world, which are up to 70 m tall. It was discovered in 1991 but it wasn't explored until 2009.



Neurosurgens call our temples "God's Little Joke" because it is the thinnest part of our skull, and a major arthery runs beneath it. The temple, also known as pteron, is the junction of four separate skull bones, and underneath it runs the middle meningeal arthery.

Pioneer
academics
Follow us
www.pioneeracademics.com