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Chapter 1 : Arthur Ashkin's optical tweezers: the Nobel Prize-winning technology that changed biology

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They are in charge of establishing national research policies. The government first set its sights on moving from a resource-based economy to one based on knowledge in its year development plan, Vision , adopted in This transition became a priority after international sanctions were progressively hardened from onwards and the oil embargo tightened its grip. This led to the adoption of incentive measures to raise the number of university students and academics, on the one hand, and to stimulate problem-solving and industrial research, on the other. It also made provision for research and technology centres to be set up on campus and for universities to develop linkages with industry. According to Article 15 of the Fifth Five-Year Economic Development Plan, university programmes in the humanities were to teach the virtues of critical thinking, theorization and multidisciplinary studies. A number of research centres were also to be developed in the humanities. In , spending stood at 0. It lays particular stress on developing university research and fostering universityâ€"industry ties to promote the commercialization of research results. After peaking at this level, higher education spending stood at 0. Higher education spending has resisted better than public expenditure on education overall. The latter peaked at 4. Women in Iran Students enrolled in Iranian universities, and Between and , student rolls swelled from 2. The most popular in were social sciences 1. Women also made up two-thirds of medical students. This is comparable to the ratio in the Republic of Korea and Thailand one in seven and Japan one in ten. Natural sciences and engineering have proved increasingly popular among both sexes, even if engineering remains a male-dominated field. Although data are not readily available on the number of PhD graduates choosing to stay on as faculty, the relatively modest level of domestic research spending would suggest that academic research suffers from inadequate funding. By , there were about 14 foreign students attending Iranian universities, most of whom came from Afghanistan, Iraq, Pakistan, Syria and Turkey. In a speech delivered at the University of Tehran in October , President Rouhani recommended greater interaction with the outside world. In , one in seven international students in Malaysia was of Iranian origin. There is a lot of scope for the development of twinning between universities for teaching and research, as well as for student exchanges. This corresponds to an increase of more than 2 researchers, from 52 to 54 The world average is 1 per million inhabitants. In , half of researchers were employed in academia The number of firms declaring research activities more than doubled between and , from 30 to 64 The increasingly tough sanctions regime oriented the Iranian economy towards the domestic market and, by erecting barriers to foreign imports, encouraged knowledge-based enterprises to localize production. Expenditure peaked at 0. Foreign direct investment in Iran and Economy of Iran Trends in Iranian scientific publications, â€" It was intended for one-third of this amount to come from abroad but, so far, FDI has remained elusive. A law passed in provides an appropriate mechanism, the Innovation and Prosperity Fund. Public and private universities wishing to set up private firms may also apply to the fund. IDRO has set up special purpose companies in each high-tech sector to coordinate investment and business development. In , IDRO set up a capital fund to finance the intermediary stages of product- and technology-based business development within these companies. Technology start-ups in Iran , Industry of Iran , Foreign Direct Investment in Iran , and List of research parks As of , Iran had officially 31 science and technology parks nationwide. Fars Province , with 8 parks and Razavi Khorasan Province , with 7 parks, are ranked second and third after Tehran respectively.

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Chapter 2 : Math | Education Supplies | Nasco

*Math discoveries with LacerLinks [Judy Goodnow] on www.nxgvision.com *FREE* shipping on qualifying offers. Math discoveries with LacerLinks.*

Svitil Friday, November 01, Three percent of tenured professors of physics in this country are women. Nonetheless, a woman physicist stopped light in her lab at Harvard. Another woman runs the linear accelerator at Stanford. A woman discovered the first evidence for dark matter. A woman found the top quark. Three years ago, Discover started a project to look into the question of how women fare in science. We knew there were large numbers of female researchers doing remarkable work, and we asked associate editor Kathy A. Svitil to talk to them. The result of her investigation is a selection of 50 of the most extraordinary women across all the sciences. Their achievements are detailed in the pages that follow. To read their stories is to understand how important it is that the barriers facing women in science be broken down as quickly and entirely as possible. If just one of these women had gotten fed up and quitâ€”as many doâ€”the history of science would have been impoverished. Even the women who have stuck with it, even those who have succeeded spectacularly, still report that being a woman in this intensely male world is, at best, challenging and, at worst, downright disheartening. It will take goodwill and hard work to make science a good choice for a woman, but it is an effort at which we cannot afford to fail. She now heads an innovative institute where researchers develop smart low-power sensors that both compute and communicate. Bajcsy believes the sensors will be "the next revolution in technology. Barton Professor of Chemistry, California Institute of Technology Barton discovered that DNA conducts electric current but not as wellâ€”or not at allâ€”when its tight organization is disrupted by damage from certain chemicals or mutations. That finding should allow researchers to look for mutations, using chips made of strands of DNA attached to gold on silicon wafers. Barton is investigating whether nature has developed tactics to cope with such damage: Where are electrons funneled? This makes us think about DNA in an entirely new way. Behrensmeyer Research Paleobiologist, Smithsonian Institution Behrensmeyer has spent almost three decades at Amboseli Park in Kenya watching animals disintegrate and fossilize as she researches taphonomyâ€”the science of burial. Did it have hard parts? Did it die in the water where it could more easily be buried and preserved? To protect vital genes from being lopped off, chromosomes are capped with telomeres, blocks of DNA and protein. Telomeres are maintained by telomerase, an enzyme discovered by Blackburn see story Why science must adapt to women and biologist Carol Greider. In most healthy cells, telomerase production eventually ceases, telomeres whittle down, and the cell dies. It is a great favorite of cancer cells," and thus a target for new drugs. The chimps can add, subtract, understand fractions, and associate Arabic numerals with the quantity of objects they represent. Now she studies the movement of electrical charges through DNA. And the properties of DNA could be useful in assembling circuit elements in nano-electronic circuits. Her work helped spur a revolution in conservation policy, uniting economists and ecologists. Now, using giant particle colliders, she studies elementary particle physics. Because I have young kids, I think of it as finding the smallest Lego that you can make everything else out of. Dresselhaus Professor of Physics and Electrical Engineering, MIT Before her fourth child hit kindergarten, Dresselhaus deciphered the electronic structure of graphite, the lowest-energy solid-state form of carbon. The daunting problem had long scared off other researchers, which is why she chose it: Sylvia Earle Explorer in Residence, National Geographic Society This oceanographer, diver, and developer of deep submersibles is systematically surveying U. For three decades, she has campaigned for public awareness of the need to protect ocean systems. That discovery, made by Faber in , "showed that galaxies were made according to some kind of regular process. Melissa Franklin Professor of Physics, Harvard University "I build things, and then I fix them when I build them badly," says the experimental physicist, offering a deceptively modest description of her work. The objects she tinkers with are complex particle detectors, including the powerful proton-antiproton Collider Detector at Fermilab in Batavia, Illinois, which she used to spot the top quark in Goldman-Rakic Professor of Neurobiology, Neurology, and Psychiatry, Yale University The persistent firing of neurons in the prefrontal cortex is the "glue of consciousness," says neurobiologist Goldman-Rakic. Instead,

throughout life, neurons sprout in the hippocampus, perhaps forging new memories, while others die from stress or wither from disuse. Hahn Professor of Medicine and Microbiology, University of Alabama at Birmingham About 70 years ago, a global pandemic that has claimed more than 60 million lives began after HIV-1, the virus that causes AIDS in humans, jumped from chimpanzees to people. Lene Vestergaard Hau Professor of Applied Physics, Harvard University Hau was the first to bring light, which moves at a constant, breakneck pace of , miles per second in a vacuum, to a screeching halt. She did it within a cloud of sodium atoms cooled to a few billionths of a degree above absolute zero. When we feel like it, we let them loose again and send them on their way," says the physicist, who is trying to miniaturize the experiment. Hoffman Professor of the Graduate School, University of California at Berkeley The very heaviest elements, those more massive than plutonium, are also the most elusive, with very short-lived stable states. Nuclear science, she points out, was started in large part by women, among them Marie Curie. A more efficient technique, developed by Howell, plays off the unseen free energy in the solar system. Nuclear Regulatory Commission and now at Rensselaer: So I view myself as both a visionary and a pragmatist. She used magnetic traps and lasers to create a similar state with fermions. Fermion gas was teased down to less than one-third of a millionth of a degree above absolute zero, a temperature at which particles act like waves. The resulting quantum gas could shed light on how superconductors work. Fifteen years later, she proved that breast cancer can be inherited. She has used polymerase chain reactions and genetic sequencing to reunite kidnapped Argentinean children with their families and also identified the remains of Americans missing in action and war crimes victims in Bosnia. Her work has shown that, like DNA, proteins can carry inherited traits through generations. She was also a key figure in the development of applications that run on distributed collections of computers connected by a network. Now she concentrates on Byzantine fault-recovery programs, which protect sensitive data from malfunction and malicious attacks. Liu Vice Chairman, Transgene, Strasbourg, France HIV mutates so quickly that it can outmaneuver traditional vaccines made from viral proteins or weakened viruses. Worse, a vaccine made from a weakened virus could prove deadly if the virus mutated and regained virulence. Until last June, the biochemist held the American single-flight endurance recordâ€” days aboard the Russian Mir space station. She says the voyage was never boring: That is ridiculous," says the evolutionist, who argues against the conventional wisdom commonly but incorrectly attributed to Darwin that random mutations lead to new species. According to her widely accepted theory, the fusion of early bacteria gave rise to the first nucleated cells. Further mergers produced their chloroplasts, mitochondria, and other cellular structures. Her "danger model" suggests new ways to treat cancer and sustain transplants, as well as immunize newborns: The evidence is there. She has a gift for encouraging scientists and engineers to work together: Her studies probe the mysteries of phase transitions, changes from one state of matter to another. She continues to study the crater "to understand how this event could have not only caused a mass extinction but also how it affected the evolution of life. It is the first quantitative evidence, she says, "for an effect of global climate change on an infectious disease. She says "the weathering of mountain ranges scrubs CO 2 out of the atmosphere, which can lead to global cooling. We have such a rudimentary understanding of the carbon cycleâ€”which controls life on Earthâ€”that anything we learn about it will help us understand future change. This swapping, or translocation, is now known to cause several forms of cancer. Instead, they move quickly, pulled around by the gravity of dark matter. Now, in addition to leading Carnegie, Singer has set up training courses for schoolteachers in Washington, D. By and large, teachers are just not equipped to do this. But I was young and foolish, and it sounded like a great adventure," says the atmospheric chemist. Tilghman says that fathers, "who have no investment in the nutrition of their offspring, want them as large as possible because large offspring survive better in the wild, while mothers want them smaller. So fathers silence genes that slow down growth, and mothers silence genes that promote growth. What is optimum for the species is balancing those opposite inclinations. Watson has spent four decades tracking their movements and sifting through their refuse: She says the caves "are a universe of their own, with almost inexhaustible research potential. Those wiggles are termed the "Widnall instability," and, by discovering them, this scientist rewrote the book on fluid dynamics. Former secretary of the Air Force, Widnall leads a program at MIT that searches for ways to improve the efficiency of the aerospace industry. Terrie Williams Professor of Biology, University of

California at Santa Cruz Although Williams studies the physiology of large predators, from cheetahs to killer whales, she specializes in marine mammals. Her innovative use of video cameras and computer modeling has offered unprecedented insights into the behavior of species previously unobserved in their daily routines. She has shown that dolphins and other marine mammals spend a lot of time gliding rather than swimming to reduce oxygen consumption. The finding solved the mystery of how they manage to stay underwater as long and dive as deeply as they do. Today she looks for new drugs to fight AIDS and other diseases. Her most recent strategy for combating HIV focuses on understanding genes in humans that help the virus enter cells and successfully infect a host. Attacking HIV directly has failed, she says, "because the virus is a moving target and can readily develop resistance. Her goal is to "figure out the processes that acted on a particular body in the past in order to make its surface the way it is now. Many have passed long days and nights in the lab stirring noxious concoctions or gathering piles of data only to see the credit for their discoveries awarded to a male colleague. Sometimes the work was obscured by a famous mentor. Here is a selection of female scientists who deserve greater notice: Her collaborator, Otto Hahn, who stayed behind in Germany, was the sole recipient of the Nobel Prize in chemistry in

Chapter 3 : Judy Goodnow: List of Books by Author Judy Goodnow

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Archimedes used the method of exhaustion to approximate the value of pi. The history of mathematics can be seen as an ever-increasing series of abstractions. The first abstraction, which is shared by many animals, [16] was probably that of numbers: Many early texts mention Pythagorean triples and so, by inference, the Pythagorean theorem seems to be the most ancient and widespread mathematical development after basic arithmetic and geometry. It is in Babylonian mathematics that elementary arithmetic addition , subtraction , multiplication and division first appear in the archaeological record. The Babylonians also possessed a place-value system, and used a sexagesimal numeral system, still in use today for measuring angles and time. His textbook Elements is widely considered the most successful and influential textbook of all time. Other notable developments of Indian mathematics include the modern definition of sine and cosine , and an early form of infinite series. The most notable achievement of Islamic mathematics was the development of algebra. Other notable achievements of the Islamic period are advances in spherical trigonometry and the addition of the decimal point to the Arabic numeral system. During the early modern period , mathematics began to develop at an accelerating pace in Western Europe. The development of calculus by Newton and Leibniz in the 17th century revolutionized mathematics. Leonhard Euler was the most notable mathematician of the 18th century, contributing numerous theorems and discoveries. Perhaps the foremost mathematician of the 19th century was the German mathematician Carl Friedrich Gauss , who made numerous contributions to fields such as algebra , analysis , differential geometry , matrix theory , number theory , and statistics. Mathematics has since been greatly extended, and there has been a fruitful interaction between mathematics and science, to the benefit of both. Mathematical discoveries continue to be made today. According to Mikhail B. The overwhelming majority of works in this ocean contain new mathematical theorems and their proofs. The word for "mathematics" came to have the narrower and more technical meaning "mathematical study" even in Classical times. In Latin, and in English until around , the term mathematics more commonly meant "astrology" or sometimes "astronomy" rather than "mathematics"; the meaning gradually changed to its present one from about to This has resulted in several mistranslations. It is often shortened to maths or, in North America, math. Today, no consensus on the definition of mathematics prevails, even among professionals. Brouwer , identify mathematics with certain mental phenomena. An example of an intuitionist definition is "Mathematics is the mental activity which consists in carrying out constructs one after the other. In particular, while other philosophies of mathematics allow objects that can be proved to exist even though they cannot be constructed, intuitionism allows only mathematical objects that one can actually construct. Formalist definitions identify mathematics with its symbols and the rules for operating on them. Haskell Curry defined mathematics simply as "the science of formal systems". In formal systems, the word axiom has a special meaning, different from the ordinary meaning of "a self-evident truth". In formal systems, an axiom is a combination of tokens that is included in a given formal system without needing to be derived using the rules of the system. Mathematics as science Carl Friedrich Gauss , known as the prince of mathematicians The German mathematician Carl Friedrich Gauss referred to mathematics as "the Queen of the Sciences". The specialization restricting the meaning of "science" to natural science follows the rise of Baconian science , which contrasted "natural science" to scholasticism , the Aristotelean method of inquiring from first principles. The role of empirical experimentation and observation is negligible in mathematics, compared to natural sciences such as biology , chemistry , or physics. Albert Einstein stated that "as far as the laws of mathematics refer to reality, they are not certain; and as far as they are certain, they do not refer to reality. Mathematics shares much in common with many fields in the physical sciences, notably the exploration of the logical consequences of assumptions. Intuition and experimentation also play a role in the formulation of conjectures in both mathematics and the other sciences. Experimental mathematics continues to grow in importance within mathematics, and computation and simulation are playing an increasing role in both the sciences and

mathematics. The opinions of mathematicians on this matter are varied. Many mathematicians [46] feel that to call their area a science is to downplay the importance of its aesthetic side, and its history in the traditional seven liberal arts ; others[who? One way this difference of viewpoint plays out is in the philosophical debate as to whether mathematics is created as in art or discovered as in science. It is common to see universities divided into sections that include a division of Science and Mathematics, indicating that the fields are seen as being allied but that they do not coincide. In practice, mathematicians are typically grouped with scientists at the gross level but separated at finer levels. This is one of many issues considered in the philosophy of mathematics. At first these were found in commerce, land measurement , architecture and later astronomy ; today, all sciences suggest problems studied by mathematicians, and many problems arise within mathematics itself. But often mathematics inspired by one area proves useful in many areas, and joins the general stock of mathematical concepts. A distinction is often made between pure mathematics and applied mathematics. However pure mathematics topics often turn out to have applications, e. This remarkable fact, that even the "purest" mathematics often turns out to have practical applications, is what Eugene Wigner has called " the unreasonable effectiveness of mathematics ". For those who are mathematically inclined, there is often a definite aesthetic aspect to much of mathematics. Many mathematicians talk about the elegance of mathematics, its intrinsic aesthetics and inner beauty. Simplicity and generality are valued. He identified criteria such as significance, unexpectedness, inevitability, and economy as factors that contribute to a mathematical aesthetic. Notation, language, and rigor Main article: Mathematical notation Leonhard Euler , who created and popularized much of the mathematical notation used today Most of the mathematical notation in use today was not invented until the 16th century. Modern notation makes mathematics much easier for the professional, but beginners often find it daunting. According to Barbara Oakley , this can be attributed to the fact that mathematical ideas are both more abstract and more encrypted than those of natural language. Mathematical language also includes many technical terms such as homeomorphism and integrable that have no meaning outside of mathematics. Additionally, shorthand phrases such as iff for " if and only if " belong to mathematical jargon. There is a reason for special notation and technical vocabulary: Mathematicians refer to this precision of language and logic as "rigor". Mathematical proof is fundamentally a matter of rigor. Mathematicians want their theorems to follow from axioms by means of systematic reasoning. This is to avoid mistaken " theorems ", based on fallible intuitions, of which many instances have occurred in the history of the subject. Misunderstanding the rigor is a cause for some of the common misconceptions of mathematics. Today, mathematicians continue to argue among themselves about computer-assisted proofs. Since large computations are hard to verify, such proofs may not be sufficiently rigorous. Nonetheless mathematics is often imagined to be as far as its formal content nothing but set theory in some axiomatization, in the sense that every mathematical statement or proof could be cast into formulas within set theory. Areas of mathematics and Glossary of areas of mathematics An abacus , a simple calculating tool used since ancient times Mathematics can, broadly speaking, be subdivided into the study of quantity, structure, space, and change i. In addition to these main concerns, there are also subdivisions dedicated to exploring links from the heart of mathematics to other fields: While some areas might seem unrelated, the Langlands program has found connections between areas previously thought unconnected, such as Galois groups , Riemann surfaces and number theory. Foundations and philosophy In order to clarify the foundations of mathematics , the fields of mathematical logic and set theory were developed. Mathematical logic includes the mathematical study of logic and the applications of formal logic to other areas of mathematics; set theory is the branch of mathematics that studies sets or collections of objects. Category theory , which deals in an abstract way with mathematical structures and relationships between them, is still in development. The phrase "crisis of foundations" describes the search for a rigorous foundation for mathematics that took place from approximately to Mathematical logic is concerned with setting mathematics within a rigorous axiomatic framework, and studying the implications of such a framework. Therefore, no formal system is a complete axiomatization of full number theory. Modern logic is divided into recursion theory , model theory , and proof theory , and is closely linked to theoretical computer science ,[citation needed] as well as to category theory. In the context of recursion theory, the impossibility of a full axiomatization of number theory can also be

formally demonstrated as a consequence of the MRDP theorem. Theoretical computer science includes computability theory , computational complexity theory , and information theory. Complexity theory is the study of tractability by computer; some problems, although theoretically solvable by computer, are so expensive in terms of time or space that solving them is likely to remain practically unfeasible, even with the rapid advancement of computer hardware.

Chapter 4 : Modern Science Museum In Seattle WA | Pacific Science Center

People make new mathematical "discoveries" everyday. Well, I suppose it really depends on what you mean by the term "discoveries." If proving results and building theories counts, then we are on the same page. Below are some notable, recent mathematical discoveries, which constitute a far.

Messenger The Nobel Prize in Physics has been awarded to three pioneers of the laser technology that has made a big impact on the world. The other recipient was Arthur Ashkin for his groundbreaking work on optical tweezers. But how can light be used to move matter? The energy carried by light is fundamental to life on our planet. But as well as energy, light beams also have a momentum, which is called radiation pressure. This means that if I shine a laser pointer at you, in addition to making you ever so slightly hotter, it will push you away with a very small force. To use this force to lift something as big as, say, an apple would be almost impossible. The laser power required would run to many megawatts, probably enough to vaporise the apple before it got off the ground. But when an object gets ten times smaller in each direction it also gets 1, times lighter. So moving from something the size of an apple to a single cell means that the laser power needed to lift it falls from megawatts to milliwatts, a similar power to that of a laser pointer. Nobel Foundation As long ago as , Ashkin working at the world famous Bell Telephone Laboratories began studying how you could use radiation pressure to accelerate and trap individual particles. Over the next 15 years he refined his ideas, brilliantly making the laser systems involved ever less complicated as time went on. In , working with Steven Chu who later won his own Nobel Prize in Physics in for work on trapping atoms and ultimately became US secretary for energy he published his seminal paper on what we now call optical tweezers. In this paper, Ashkin showed that if the laser beam was focused very tightly using a microscope then, rather than pushing objects away with radiation pressure, it would counter-intuitively attract particles towards it. When the laser beam was then moved, the particles would follow it, held in the focus of the beam at all times. Since then, optical tweezers have been used by many physicists and engineers, who have extended the technique so that it can trap many particles at once and even transform the tweezers into optical spanners that cause the objects to spin. This later area is one of my own research interests and I remember, as a young researcher, the thrill of Ashkin asking me for a copy of my talk at a conference. Impact in biology Perhaps the greatest impact of optical tweezers has been in biophysics. Optical tweezers can be used to sort healthy cells from infected ones, or identify those that might be cancerous. It is also possible to use optical tweezers to measure both the minute movements of a trapped object equivalent to a few atoms in diameter and similarly tiny forces. Turning optical tweezers from a manipulation tool into a measurement device has allowed biologists to study the workings of the individual molecular motors which are responsible for movement in the biological world. Such motors transport chemicals within molecules, allow cells to swim and, when acting collectively, allow whole creatures to move. Ashkin showed us all just what can be done by having an idea and then seeing it through to completion. For years he worked in a minority field, pioneering and then refining his ideas inventing techniques that scientists now use as as essential tools of their trade - thank you Arthur.

Chapter 5 : When Math Discoveries Led to Banned Numbers | Mental Floss

On Tuesday, December 19, , Democrat Shelly Simonds won a seat in the Virginia House of Delegates by a single vote in a narrow-as-narrow-can-get victory. Though a court quickly tossed out.

Chapter 6 : The 50 Most Important Women in Science | www.nxgvision.com

In , Tao, then a year-old prodigy, met ErdÅ‘s at a math event. "He treated me as an equal," recalled Tao, who in won a Fields Medal, widely seen as the highest honor in mathematics.

Chapter 7 : soft question - What recent discoveries have amateur mathematicians made? - MathOverflow

He left math without getting his PhD (although his senior thesis was quite important), and became a lawyer. 10 years later, in his free time, he messed around with math and did some research. He has 6 papers listed on MathSciNet, all very important, and all post

Chapter 8 : Mathematics - Wikipedia

Three researchers shared the Nobel Prize in Physics for advances in laser physics. The winners include a woman for the first time in 55 years. Strickland became the first woman to be awarded a Nobel Prize in Physics since Maria Goeppert-Mayer in , for her "discoveries concerning nuclear shell.

Chapter 9 : Publisher: Ideal School Supply Company | Open Library

Here is a brief explanation of their breakthroughs and how the discoveries can be applied: Optical tweezers. American physicist Arthur Ashkin was given one half of the prestigious award for.