The origin of life

Geochemist says topic is hotter than people think

A

Washington University geochemist has added fuel to the fire in one of the hottest science controversies today — the origin of life.

Everett L. Shock, Ph.D., assistant professor of earth and planetary sciences, has done calculations that show thermophilic (heat-loving) microorganisms living in ultra-high temperatures may gain more energy metabolizing available nutrients than life forms that live in more temperate environments. The thermophilic bacteria, which thrive at temperatures of more than 220 degrees Fahrenheit, are found in hot springs deep in the ocean. Metabolism is the chemical cellular process in which energy is produced and released.

His findings lend credence to the theory that life on earth started through chemosynthesis, the reaction of chemicals with sunlight, rather than photosynthesis, the reaction of chemicals with sunlight. While photosynthesis, the easier life is," says Shock, "the hotter it is for these thermophile microorganisms, the easier life is."

Shock's calculations are based on extrapolations of the free energy property, a standard thermodynamic tool used to describe the energy loss or gain in a chemical reaction. Shock determined how much energy an organism would require to make peptide bonds, the links in the chains of large protein molecules. The production of peptide bonds is essential for all life forms. He also used this approach to analyze other simple chemical reactions of thermophilic bacteria, such as the reduction of sulfur to hydrogen sulfide.

Microbiologists studying bacterial metabolism have long known that microorganisms require more energy to metabolize at higher temperatures. Part of the surprise of Shock's calculations was how these curious forms of life, which no one thought existed just a generation ago, are able to live.

In This Issue...

On the verge: Treatments may be near for neurological disorders, such as stroke and Alzheimer's disease. Continued on page 6

A search for answers: Robert Walker leads one of the world's largest research groups studying extraterrestrial materials. Continued on page 2

An affordable resource: University's Psychological Service Center provides counseling for people of all economic classes. Page 6

Jennifer Basuel, a freshman chemical engineering major from Granite City, Ill., braves the cold temperatures on campus last week. This paper, "It was the temperature was zero, with a wind chill of minus 21. Local meteorologists are predicting Feb. 18 the coldest day in three years in terms of comfort. Two days earlier, eight inches of snow fell on the St. Louis area forcing the University's Hilltop Campus to cancel classes.

Continued on page 5
Glutamate is the prime transmitter of transfer or inhibitory messages that slow the brain and spinal cord can send either "Bench to Bedside: The Glutamate Connection."

Recent perspectives article in Science, titled under the headline of neurology at the School of Medicine. Such promise is driven by rapidly advancing 20 years ago neuroprotective drugs were considered somewhat of a fantasy by scientists, but now they are in the lab, and some have made it as far as the clinic. "We have a great deal of optimism about this drug," Choi says. "We hope to be an important step in neurological medicine, and even the optimism about this field," Choi says. "The discovery from excitotoxic damage caused by oxygen deprivation on cells in culture, stroke victims. Studying the effects of glutamate receptor, the AMPA receptor, it can act as a spigot to let calcium into neurons. This was one of the first hints that neuroscientists are now discussing things like zinc, calcium and NMDA receptors, but this time removing sodium ions from the bathing solution. The cells blew up, but they soon returned to normal size after Choi rinsed off the glutamate. "But," he says, "those cells still go on to die in a delayed fashion. So it's not the acute swelling that's killing them."

Choi had uncovered a second mechanism in glutamate-induced cell death. Cell death in this instance, Choi reasoned, is dependent on how much calcium was released into the neuron. Choi's research led to the development of AMPA antagonists, which have proved disappointing. In animal models of cardiac arrest, where the heart is stopped, preventing blood flow to the brain, patients have not been successful in saving brain tissue. "This has been a significant challenge," Choi says. But it is important to note that blocking another type of neuronal glutamate receptor, the AMPA receptor, looks quite promising. Choi believes that under certain conditions — and apparently normal conditions — NMDA receptor is turned off. "It appears that the AMPA receptor delivers the killing blow," he says. Puzzled by the fact that the NMDA receptor, "the stone of grief," Choi calls it, is taken out of the game, he began a search for what might be able to disable the NMDA receptor. "We think that factors like hydrogen ions and zinc are important in shutting down the NMDA receptor in this situation," Choi says.

That neuroscientists are now discussing things like calcium channels and NMDA receptors bodes well for patients. Research now is in the lab, and some have made it as far as the clinic. "We have a great deal of optimism about this drug," Choi says. "The optimism isn't based so much on riding a horse that's a winning horse as it is seeing a herd of horses galloping down the street." — Jim Keleey
Robert Walker on cosmic quest for answers

As a young boy, Robert M. Walker was in high school when he promised his sweetheart "the sun, the moon and the stars." Little did he know that if the two had stayed together, he could have fulfilled that promise.

"We have samples of the moon, stars, and we have samples of the sun," says Walker, referring to the extraterrestrial materials under study at the McDonnell Center for the Space Sciences at Washington University.

As director of the McDonnell Center, Walker oversees one of the world's largest research groups involved in the search for and study of extraterrestrial materials. The interdisciplinary group is contributing fundamental knowledge about the early history of the solar system, the evolution of stars, and the formation of the chemical elements.

In his search for answers about the universe, the McDonnell Professor of Physics, has studied the first lunar samples from the Apollo missions, collected meteorites in Antarctica, analyzed extraterrestrial dust particles from the upper atmosphere and identified and measured preserved isotopic dust grains in primitive meteorites.

Walker grew up at a time he would be born up. He says that his grand-father and stepfather, both of whom played important roles in shaping his attitudes, were fractured scientists. The Hayden Planetarium and the Museum of Natural History in New York were places Walker "haunted" as a youth. "There was never any question in anyone's mind that I was going to be a scientist. The only question was which science."

The decision to pursue science came serendipitously. Walker was attending a small rural high school in upper New York state when he was a freshman in metal shop in Schenectady, N.Y., came through. As Walker recalls, "It was 1946, the year right after the war, and Union College was pushing physics. I had a senior basketball game at noon and he (the recruiter) was enroaching onto the time. So I agreed to go into physics because I wanted to get out and play basketball."

He graduated from Union in 1950, fourth in a class of 400, with a bachelor's degree in physics. He went on to earn both a master's (1951) and doctorate (1954) in physics from Yale. Walker's Ph.D. graduate students became involved in his first extraterrestrial project.

"I stepped by a lab and asked the people what they were doing and they told me they were studying cosmic rays. And I asked, "What are cosmic rays? Do you have a book?" He says he took the book home and read it that weekend. "At the time, cosmic rays were a big mystery. As it turned out, everything about cosmic rays was falling into place right at that point in time. But the book had been written not before 1946. So I knew that it was quite exciting because there were lots of things to learn."

While working on his doctoral thesis, he was the first graduate student to bring his own apparatus to the Cosmosntron, a big particle accelerator, or atom smasher, at the world renowned Brookhaven National Laboratory on Long Island. And he was among the first to show one of the fundamental properties of strange particles. He demonstrated that these particles had to be produced in pairs — that produce one kind you had to produce another kind simultaneously.

"It was an exciting time to be at Brookhaven because we had all the greats of physics there. Enrico Fermi was exposing his research in metal shop. The only question was which science?"

When Robert M. Walker was in high school, in the late 1950s, he has been involved in a project to help Third World countries help themselves. Among the needs of the Third World, Walker and a small group of colleagues in Schenectady decided to contribute their know-how to help solve technical problems in developing nations. In 1960 the group founded Volunteers in Technical Assistance (VITA), with Walker as its first president. According to a written history of VITA, Walker was the "guiding spirit" and "the real driving force" behind the organization.

Today, VITA boasts more than 7,000 engineers and scientists who volunteer their time to projects ranging from a Village Technology Pack to the communications satellite system that relays information from VITAS' Washington, D.C., headquarters to places asSomalia and Indonesia. Walker, who now serves on VITAS' board of directors, says the satellite should allow people in developing countries to have access to "every thing that is known."

Walker views one undisturbed quest to know all there is about the universe as a competitive game. "I think the competition aspect is obvious in such areas as AIDS research — the more money poured into the work in physics and extraterrestrial materials — any kind of scientists move very easily at ultra-low temperatures in pure copper.

While at GE, he gained international recognition as co-inventor of a technique that detects tracks in "scars" left in crystals by the action of nuclear particles. Walker and a colleague discovered how to make these tiny tracks visible under an ordinary microscope by using a chemical etching process. The etched tracks provide information on the age of the solids or the nature of the particles, thus providing information on the history of the earth and solar system and on cosmic radiation.

Their discovery has been applied to a variety of scientific and practical problems. As just three examples, the Xenon Corp.'s Corporate Research Group, was Washington's provost at the time and a professor of physics. The high regard Walker had for Pake, the cosmic ray researcher and director of the physics department and the promised support to build up the space sciences here from James S. McDonnell, president of McDonnell Foundation, all influenced Walker to take the job.

As Pake recalls, "Mr. McDonnell was keenly interested in finding out areas in which the university could make original contributions — that's when you can make original contributions only lasted a short time, because it turns out when you go study. "We have samples of the moon, stars, and we have samples of the sun," says Walker, referring to the extraterrestrial materials under study at the McDonnell Center for the Space Sciences at Washington University.

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Films

Thursday, Feb. 25
7 p.m. Dept. of Asian and Near Eastern Languages and Literatures Chinese Film Series presents "His Son's Big Dog" (Taiwanese with English subtitles). Room 219 South Ridgley Hall. Cost: $3.

Friday, Feb. 26
7 and 9:30 p.m. Filmboard Feature Series presents "The Princess Bride." (Also Feb. 27, same time, and Feb. 28, 9:30 p.m.) Room 100 Brown Hall. Cost: $3.

Monday, March 1
7 and 9 p.m. Filmboard Foreign Series presents "L'Argent" (French with English subtitles). (Also March 2, same time.) Room 100 Brown Hall. Cost: $3.

Tuesday, March 2
6.30 and 8.30 p.m. WU Association Travel Lecture Series presents "How to Avoid the Rocks," By Daniel Burtchart, whose films exemplify his photographic skill and love of the wilderness. Graham Chapel. Cost: $4.50 at the door. For more info., call 935-5217.

Wednesday, March 3
7 p.m. Dept. of Asian and Near Eastern Languages and Literatures Middle Ages Film Series presents "The CID" Room 219 South Ridgley Hall.

Exhibitions

"Perspectives: Jarvis Thurston and Moni Van Der Tak." Tubahi opening. 9 p.m. Feb. 26 (with readings at 7:30 p.m.). Exhibit continues through May 7. Dot Library, Speculative collections, Level 5. Hours: 8:30 a.m.-5 p.m. weekdays. Free. For more info., call 935-5495.

Calendrical

Calendar guidelines

Events sponsored by the University — its departments, schools, centers, organizations and its recognized student organizations — are posted in this Calendar free and open to the public, unless otherwise noted.

Calendar submissions should state time, date, place, sponsor, title of event, name of speaker, affiliation, and address, and submitting a proposal does not guarantee publication. Send forms to Marie Dols at Box 1070 or fax 935-4259. Submission forms are available by calling 935-4259.

The deadline for all entries is noon Tuesday, 2 weeks prior to the event. The Calendar will not be printed. The Record is printed as a final run on Saturday of the week during the school year, except holidays, and monthly during the summer. If you are uncertain about a deadline, holiday schedule, or any other information, please call 935-8353.
Series focuses on environmental issues facing legal and business community

"The Environment: Horizons in Law and Business" will be the focus of a series of panel discussions from 12:45 to 5:30 p.m. Monday in Simon Hall, John M. Olm School of Business. Registration prior to Feb. 26 costs $75. After Feb. 26, registration will cost $90. The discussions are open to the public.

Designed to provide an overview of the hottest environmental issues facing the legal and business community, the conference will feature experts from universities, corporations, government agencies and law and accounting firms. The program follows the first of four one-hour discussions on the following topics:


Children of Israel gospel choir to perform

The Children of Israel gospel choir, under the direction of Jerry Smith, one of the ministers of music for the renowned Mississippi Mass Choir, will perform at 11 a.m. Sunday in the Hoxie Chapel. The program, honoring the late John B. Ervin, a nationally recognized educator and dean of the University’s School of Continuing Education from 1968 to 1977, is part of the Assembly Series and is free and open to the public.

Fornos has done background vocals for the Williams Brothers, Smithfield, Miss., and their group has done background vocals for the Wilsons, Philadelphia, Pa., one of the members of the Children of Israel. The Miss Choir Mass Choir which has won numerous honors and awards for its contributions to gospel music.

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Men's Basketball

Last Week: Washington 81, Brandeis 71; Washington 78, Rochester 79

This Week: University of Chicago, 8 p.m. Saturday, Feb. 27, Washington Field House, Session Four. Current Record: 14-10, 9-4 in UAA. Fueled by a miraculous comeback against the University of Rochester, the Bears have clinched a second consecutive spot in the University Athletic Association (UAA) standings. In addition, Friday’s win over Brandeis University assured the Red and Green of a school-record ninth-straight winning season.

On Sunday, the Bears seemed doomed to defeat, trailing defending national runner-up Rochester by 10 points with 1 minute and 44 seconds remaining. At that point, freshman Brent Dalrymple, Des Peres, Mo., drew a charging foul on the subsequent inbounds pass and made both free throws. Suddenly, the Bears had drawn within five points. Washington continued to close the gap, drawing within three points on free throws by the Yellowjackets. With two seconds remaining, sophomore Denise Nolan, Chicago, Ill., buried a 24-foot jumper to give the Bears their first win in

Women's Basketball

Last Week: Washington 58, Brandeis 43; Washington 70, Rochester 67

This Week: University of Chicago, 6 p.m. Saturday, Feb. 27, Washington Field House. (Regular Season Finale) Current Record: 21-3, 11-2 in UAA.
Psychological Service Center provides affordable help

Washington University's Psychological Service Center not only acts as a resource for people of all ages, but also it provides training for fledgling clinical psychologists.

The center, which was established 19 years ago, provides intensive training for the University's graduate psychology students. For every hour a graduate student spends counseling a patient, the student spends another hour reviewing the session with a faculty supervisor or a private practitioner supervisor.

Through this system, the center provides an affordable rsource for counseling that isn't available elsewhere in the St. Louis community. The center uses a sliding fee scale, so all patients are charged, but only according to their ability to pay. Fees range from $12 to $80 per hour. Amy D. Bertelson, Ph.D., center director, says many of the patients are referred by therapists in private practice because of the sliding fee scale. Money received from patients helps run the center.

Located on the first floor of Eads Hall, the center is run by a private doctor's office. The center's decor and design are soothing. The four individual therapy rooms are cozy, with overstuffed chairs and thick carpeting. A children's room is equipped with books and a chalkboard hung at child height.

With a staff of 15 graduate students, the center sees about 60 patients a week. A typical patient comes for about 14 sessions, says Bertelson, though some need only one or two sessions and some people come for as long as three years. Typically, there is a single problem that motivates someone to come to the clinic, but then it expands beyond that to other issues that crop up in the course of the treatment.

Four Washington University faculty members and 14 clinical psychologists in private practice supervise the graduate students.

This supervision is done as a courtesy by the private practitioners. They are not paid for their time. Bertelson says this arrangement is especially helpful to the graduate students because they are able to talk to the psychologists' private offices and watch them at work.

Donna McCulloch, a graduate student in the Psychological Service Center, associates the center, agrees: "Working with individual faculty has been a great experience for me," says McCulloch, who has five supervisors, all of whom in private practice. "The best part about being supervised by private practitioners is that you get a taste of all different types of orientation. I learn how different people conduct therapy, because there are many different styles. I can incorporate them all into my own style."

Graduate student Rebecca Allen-Burge agrees that the supervisor system is a real plus to the program. "It definitely gives us more information, we get a bigger picture," says Allen-Burge, adding that therapists who see patients daily often approach their work in a very practiced, procedural way. "Some people are seeing my behavior, some eating disorders and problems with relationships. In addition to adapting to different methods, we also are seen."

Bertelson says the center has been at the center for more than 10 years. Over that time Bertelson says she has seen more and more private practitioners coming in who are uninsured.

"We are a good resource for clients who can't afford private practitioners," says Bertelson. "But over the last few years we are seeing more and more unemployed people."

The service center is not a hotline or walk-in site for suicide or drug and alcohol or other immediate crises. The center also does not provide treatment for alcohol or drug abuse, or prescribe medication.

Bertelson also emphasizes that the center is not affiliated with the Student Health Center. The University offers a service specifically for full-time students, both graduate and undergraduates, for up to 10 hours per school year. The Student Counseling Service, however, only has five supervisors. Occasionally, Bertelson says, students need more sessions and are then referred to the Psychological Service Center.

For more information about the Psychological Service Center, call 935-6555.

Newly discovered life forms give clues to origin of life—page 1

"These forms of life are worth studying because they give us clues to how life got started," says Shock. "Much of what I do in this area revolves around a basic question: could simple organic compounds such as acetic acid, formic acid and glycine form in a hydrothermal system? Is there a set of natural conditions that is conducive to organic synthesis? My results so far indicate the most likely conditions for organic synthesis in a hydrothermal system are at about 150 to 200 degrees C (302 to 392 F)."

In the mid-1970s, marine scientists in special submarines went nearly two miles below sea level, where the temperature is about 0 to 2 degrees C (32 to 36 F), and were startled to discover the existence of mysterious sea clams, tubeworms and many other odd species that had never before been documented. The organisms were found near hot springs or structures dubbed "black smokers," sea-floor chimneys that spew magma-heated water from the Earth's mantle. Water temperatures directly at these structures reach as high as 350 degrees Celsius, or more than 660 degrees Fahrenheit.

Because of the presence of these large, complex species in the absence of sunlight, microbiologists theorized that the primary sources for these species must be chemosynthetic bacteria. They began to wonder what temperature range would be viable for these heat-loving bacteria, and theorized that the microorganisms possibly could live in the lower temperature range of the hot springs. But it was impossible to tell without microscopic specimens.

Then, in a series of discoveries beginning in the early '80s, scuba-diving microbiologists confirmed the existence of bacteria in hot springs below sea level off the coasts of Sicily, Iceland and New Zealand. The temperatures at which these organisms thrive range from nearly 100 degrees C (212 degrees F) to 112 degrees C (234 degrees F). The discoveries sparked speculation that thermophilic microbes might even be able to exist at temperatures as high as 150 degrees C (302 degrees F).

"We've found some for which these microorganisms have been eating simple organic compounds," says Shock. "I'm intrigued in the genetic controls on these organisms and the conditions in natural systems that determine what compounds are there and what their value is for metabolism. My feeling is if the food— the simple chemical compounds—is there and abundant enough, there'll be some thing in these environments to take advantage of the food."

Alternative energy sources

Plants and animals at the surface of the Earth — including people — rely on photosynthesis to live, but life's less familiar forms, such as the thermophilic bacteria, use other sources of energy. Because sunlight cannot penetrate the ocean waters any deeper than about 325 feet, chemosynthesis is the thermophilic bacteria's metabolic choice.

For instance, hydrogen sulfide comes into sea water from the hot springs and certain species of these bacteria (C. pasteurii) have found a chemical way to make sulfur from the hydrogen sulfide, providing them with sulfur for their metabolic life form, to reproduce. Others obtain natural sulfur in the form of sulfuric acid and use it to reduce sulfuric acid and can live attached to sulfur crystals. In many ways, we employ a similar process in our metabolism. To ingest high-energy calories and nutrients from the food, we metabolize our metabolism and give us energy.

There is a wild kingdom of weird creatures in the hydrothermal vents. They are very different organisms recently have discovered and started to consider. In addition to thermophilic microorganisms that crave conditions in oceanic hot springs, there are acidothrophic organisms that can survive in oceanic hot springs. They thrive only in environments so acidic that we would burn our hands to touch them. There are halophilic organisms that love salt-saturated solutions—a favorite roost is the surface of sodium chloride crystals.

One of Shock'savorites is a kind of microorganism that can live off sulfur minerals. Found in extremely dry valleys of Antarctica, these organisms stay dormant in the dry mud, waiting as long as a year for precipitation, which would allow them to multiply. They can metabolize the chemicals from the minerals and reproduce. "That's like waiting for the rain to water a garden, wait for the can't rain," says Shock. "Yet, that's how these halophilic organisms survive."

"We know there is life above 100 degrees C. If you think of the volume of oceans, there are lots of areas between 0 degrees C and 150 degrees C, it opens an enormous, exploitable realm where biologists almost inevitably from things we normally see like trees and squirrels and birds to who knows what."

Tony Fitzpatrick
Students learn Japanese economic wows too

A contingent of 56 Executive MBA students from the Olin School of Business has returned from an intensive one-week tour of Tokyo with some very positive experiences in Japan. "The big surprise was the pervasiveness of Japanese concern about their own economic future," says Richard J. Scaldini, Ph.D., associate dean and director of executive programs at the Olin School. "It's as if the Japanese have discovered their own economic problems and are exploring them.

The Japan trip is a mandatory component of Olin's Executive MBA program for second-year students. The trip was carefully planned and organized to give business students a broad introduction to the business principles and realities of Japan. The trip is funded by the Japanese government and is designed to train students to be effective in an international business environment.

Scaldini asserts that the trip gives students an opportunity to develop the skills and experiences necessary for effective business leadership in the global marketplace. The trip is intended to provide students with an understanding of the Japanese business culture and to prepare them for successful careers in Japan.

The trip itinerary includes visits to major Japanese companies, such as Sony, Toyota, and Mitsubishi. Students also have the opportunity to meet with Japanese business leaders and to participate in panel discussions with Japanese business professionals. The trip also includes visits to cultural attractions, such as the Japanese Garden in Tokyo and the traditional tea ceremony.

Scaldini encourages students to explore research projects that allow them to explore the cultural, economic, and social aspects of Japanese business and culture. The trip is designed to prepare students for success in Japan and to help them understand the unique cultural and economic factors that influence business practices in Japan.

For more information about the trip and its impact on students, please contact Richard J. Scaldini, Ph.D., associate dean and director of executive programs at the Olin School.
Hilltop Campus

The following is a partial list of positions available at the School of Medicine. Employees who are interested in transferring should apply. Please send a resume to: Associate Vice Chancellor for Research, Room 63110. Washington University, Campus Box 8802, St. Louis, Mo. 63110.

Director

Research Office. Requirements: Master's degree, doctorate, or comparable degree. Knowledge of how to promote corporate support for medical research; develop a networking capability through personal interaction with medical school faculty and corporate research managers. Interface with Research Office staff involved with technology transfer (patents and licensing). Graduate level training in science or business required; up-to-date technical knowledge of several of the following: biotechnology, pharmacology, medical devices and medical imaging; ability to extrapolate from scientific to commercial application required. Strong syntactical and analytical skill and presentation abilities needed. Deadline is March 15. Applicants should send a CV and letter indicating their qualifications and addresses and phone numbers of three references to: Associate Vice Chancellor for Research, Washington University, Campus Box 8011, 724 S. Euclid Ave., St. Louis, Mo. 63110.

Architectural Drafter II

930149. Facilities Planning and Management. Requirements: Associate or equivalent degree in architectural drafting; approximately five years CAD experience; must be knowledgeable with and able to use AUTOCAD with a DXF file through version 12, approximately five years drafting experience; cooperative team player who can stay focused in busy environment; assure responsibility, show initiative and good mechanical aptitude; must be able to work independently or under general direction on construction-related projects. Resume and three letters of recommendation required.

Accounting Clerk

930151. Biology. Requirements: Must be high school graduate, certificate or associate's degree preferred; typing with accuracy; computer knowledge and skills; demonstrated abilities of understanding and budgeting; sound judgment skills; clerical and verbal skills; demonstrated abilities in developing and using Excel spreadsheets on a Macintosh computer; and in inputting and using other financial systems; knowledge of TDS and grants budgeting strongly preferred; requires ability to handle simultaneous, multiple assignments, work under pressure, provide effective support and interact with a diverse group; must display a high degree of independent judgment, initiative and the ability to work with minimal supervision; strong organizational skills; familiarity with WordPerfect 5.1; excellent language, spelling, grammar and punctuation skills; computer knowledge of WordPerfect, MS Word; and using other financial systems; knowledge of accounting and budgeting, including understanding of complement synthesis in inflammation, required. preferably in outpatient services; basic experience, very desirable; coursework in mathematics and sciences helpful; experience in MS DOS and Unix. Requirements: High school graduate/equivalent, one year of related experience, or associate's degree. Strong interpersonal and communication skills; ability to work independently and as a team; ability to work under deadline pressures and effectively promote smooth function between different departments with temporary employees. Resume and three letters of recommendation required.

Manager for Mail Operations

940155. Undergraduate Admissions. Requirements: Bachelor's degree preferred; physically capable of lifting/transferring heavy boxes (up to 50 lbs.); knowledge of U.S. postal regulations preferred; time management and ability to prioritize; attention to detail and recordkeeping skills a must; ability to be flexible and manage time effectively; ability to delegate, supervise, and direct; familiarity with office procedures and policies. Resume and three letters of recommendation required.

Director, Sponsored Projects Services

Research Office. Requirements: Bachelor's degree. Must have good written and oral communication skills; must have good written and oral communication skills; must be knowledgeable with and able to use AUTOCAD with a DXF file through version 12, approximately five years drafting experience; cooperative team player who can stay focused in busy environment; assure responsibility, show initiative and good mechanical aptitude; must be able to work independently or under general direction on construction-related projects. Resume and three letters of recommendation required.

Financial Analyst

930146. Biology. Requirements: Bachelor's degree. Assist in preparation, analysis and review of yearly operating budget documents; prepare and interpret approximate year-end analysis; do special research projects within the budgetary area as requested; develop and maintain the appropriate data; prepare reports and analyses of cash flow; attend weekly budget council meetings; participate in summer seminar reports on contingency budgets, tuition allocation, other expenses and salary; assist departmental staff with budgeting and accounting questions; process departmental budget adjustments and review check requests; demonstrate working knowledge of Arts and Sciences guidelines and procedures to provide assistance to the director in the proper implementation of school procedures. Resume and three letters of recommendation required.

Contract and Grant Coordinator

930853. School of Social Work. Requirements: Bachelor's degree with accounting background; strong communication and interpersonal skills; experience in funded research and administration and working with federal governmental agencies and foundations; PC word processing and spreadsheet skills; ability to organize and work on deadline; typing 40 wpm with accuracy. Clerical testing and three letters of recommendation required.

Administrative Assistant

93101. Chemical Engineering. Requirements: High school graduate or college preferred; typing 50 wpm with accuracy; as much as five years office experience beneficial, especially if the individual interacted with others. Some supervisory experience is required. Clerical testing and three letters of recommendation required.

Researcher

931041. Development Services. Requirements: Bachelor's degree, liberal arts background preferred; ability to research and writing skills; typing 35 wpm with accuracy. Application, resume and three letters of recommendation required.

Project Manager

931043. Facilities Planning and Management. Requirements: College degree in engineering/construction field; minimum four years project-management experience in both design and construction; ability to communicate effectively, especially if the individual interacted with others. Some supervisory experience is required. Clerical testing and three letters of recommendation required.

Financial Analyst

931036. School of Fine Arts. Requirements: Bachelor's degree, liberal arts background preferred; ability to research and writing skills; typing 35 wpm with accuracy. Application, resume and three letters of recommendation required.

Librarian

930151-R. Medical Library. Responsibilities: Monday-Friday, 8 a.m. to 5 p.m.; Saturday, 9 a.m. to 5 p.m., Sunday 1-5 p.m. (rotation). Requirements: High school graduate, certificate or associate's degree preferred; typing 50 wpm with accuracy. Familiarity with University procedures and policies; provide assistance to the director in the proper implementation of school procedures. Resume and three letters of recommendation required.

Director, Sponsored Projects Services

Research Office. Requirements: Bachelor's degree. Assist in preparation, analysis and review of yearly operating budget documents; prepare and interpret approximate year-end analysis; do special research projects within the budgetary area as requested; develop and maintain the appropriate data; prepare reports and analyses of cash flow; attend weekly budget council meetings; participate in summer seminar reports on contingency budgets, tuition allocation, other expenses and salary; assist departmental staff with budgeting and accounting questions; process departmental budget adjustments and review check requests; demonstrate working knowledge of Arts and Sciences guidelines and procedures to provide assistance to the director in the proper implementation of school procedures. Resume and three letters of recommendation required.

Director

Research Office. Requirements: Master's degree, doctorate or comparable degree. Bachelor's degree preferred; years business experience, including general accounting responsibilities desired; ability to interpret and communicate policy and procedures a must; should have good personal and organizational skills and be able to work under pressure. Typing speed 30 wpm and CRT experience.

Head Technologist

930546-R. Pediatrics. Requirements: Bachelor's degree in molecular biology or related field will be considered. Experience in a research lab a must. Will handle regulations and oversights in cell and molecular biology research, including safety, labhouse and general lab management; ability to work independently and as a team; good organizational skills and be able to work under pressure. Typing speed 30 wpm and CRT experience.

Library Assistant

930548-R. Medical Library. Requirements: High school graduate/equivalent; some college preferred; minimum one year library experience required. Public contact experience essential. Clerical and clerical skills are desirable; typing 35 wpm. Typing speed 30 wpm and CRT experience.

Lead Lab Tech I

930555-R. Pathology. Schedules: Full time; including rotating weekends and holidays. Experience: Minimum one year of experience in a high volume, fast-paced laboratory; ability to work independently a must. Will handle responsibility for department efficiency and well organized to meet the demands of a busy practice.

Clinical Research Coordinator

930537-R. Neuroscience. Requirements: Bachelor's degree, master's degree preferred. Five years nursing experience with at least one year of pediatric nursing; prefer experience with clinical trials. Excellent communications skills and be efficient and well organized to meet the demands of a busy practice.

Grant Assistant II

930541-R. Administration. Requirements: High school graduate or college preferred; three years business experience, including general accounting responsibilities desired; ability to interpret and communicate policy and procedures a must; should have good personal and organizational skills and be able to work under pressure. Typing speed 30 wpm and CRT experience.

Contract and Grant Coordinator

930853. School of Social Work. Requirements: Bachelor's degree with accounting background; strong communication and interpersonal skills; experience in funded research and administration and working with federal governmental agencies and foundations; PC word processing and spreadsheet skills; ability to organize and work on deadline; typing 40 wpm with accuracy. Clerical testing and three letters of recommendation required.

Business Analyst

93101. Chemical Engineering. Requirements: High school graduate or college preferred; typing 50 wpm with accuracy; as much as five years office experience beneficial, especially if the individual interacted with others. Some supervisory experience is required. Clerical testing and three letters of recommendation required.

Researcher

931041. Development Services. Requirements: Bachelor's degree, liberal arts background preferred; ability to research and writing skills; typing 35 wpm with accuracy. Application, resume and three letters of recommendation required.

Project Manager

931043. Facilities Planning and Management. Requirements: College degree in engineering/construction field; minimum four years project-management experience in both design and construction; ability to communicate effectively, especially if the individual interacted with others. Some supervisory experience is required. Clerical testing and three letters of recommendation required.

Financial Analyst

931036. School of Fine Arts. Requirements: Bachelor's degree, liberal arts background preferred; ability to research and writing skills; typing 35 wpm with accuracy. Application, resume and three letters of recommendation required.