

# FACULTY newsletter

CPMS Physical and Mathematical Sciences



Zare

ABOVE Dr. Richard Zare

## Respected Stanford Chemist to Lecture

Hear Dr. Zare talk about his views on success, problem solving and presidential personalities at <http://cpms.byu.edu/izatt-christensen-zare-chem-lecture/>.

With a National Medal of Science, numerous scientific publications on everything from Martian meteorites to laser chemistry and more than thirty years at Stanford University, Richard N. Zare has had a long and successful career. On Feb. 7, he will speak to the community and share his thoughts on how to be successful.

Zare will be visiting BYU to give two lectures as part of the annual Izatt-Christensen lecture. On Tuesday, Feb. 7, Zare will lecture to the general public. His address is titled "How to Be Successful." Admission is free, and all members of the community are invited to attend.

Although he has had a successful career, Zare admitted that the title of his lecture, "How to Be Successful," may sound a bit presumptuous.

"Who would dare use such a title, right? Who can say to others for sure how to be successful?" Zare said. "It's a topic I've been fascinated about for quite some time; it's interesting because

so few people actually write about it."

During the lecture, Zare plans to share some thoughts on how to lead a successful life and have a successful career.

Life is full of problems, according to Zare, and he thinks it is very important to approach those problems in the right way.

"Very few people tell you anything about the nature of going about problem solving; instead, often they show you how to solve problems," Zare said. "Seeing somebody slickly go through a solution to a problem very seldom really instructs you how to really — yourself — go about a problem, because that tends to be a process of flailing around trying this and that."

Zare ascribes his approach to problem solving to an attitude rather than a process.

"You need very much a spirit of playfulness and allowing yourself to fail," Zare said. "I don't do crossword puzzles with

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Bill Keach

ABOVE Dr. Bill Keach and students

## Geology Breaks New Ground in Nauvoo

In October 2011, BYU geology and archaeology students broke new ground in Nauvoo as they examined different archaeological sites. They weren't digging for buried treasure, but for new ways of looking at the early history of The Church of Jesus Christ of Latter-day Saints.

Professors Bill Keach and John McBride, from the Department of Geological Sciences, took students to Nauvoo to do field-work and to help both The Church of Jesus Christ of Latter-day Saints and the Community of Christ benefit from the students' work and data.

Those who helped launch the project include Dr. Benjamin C. Pykles, historical sites curator for The Church of Jesus Christ of Latter-day Saints; Casey Cluff, facilities manager of Nauvoo Restoration, Inc.; and Lachlan Mackay, direc-

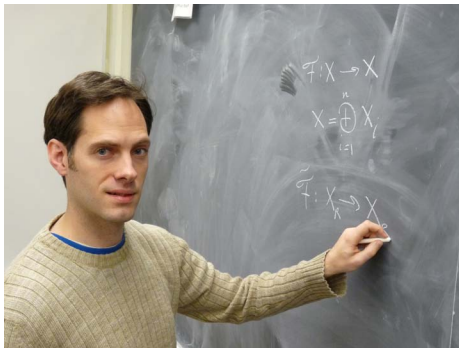
tor of historic sites for the Community of Christ. The BYU Religious Studies Center and the College of Physical and Mathematical Sciences both provided funding for the project.

The originator of the project, Dr. Pykles, initially chose the sites in Nauvoo using land records that indicated where homes had been in the past. Then Keach and McBride arrived with their students to use ground penetrating radar (GPR) to examine the sites.

Just as sonar sends out sound waves through water, GPR sends out electromagnetic waves through the ground to record what lies beneath, allowing the team to get readings through the moist, clayey soil of Nauvoo.

"Part of the project is just proving that the science works in Nauvoo, and it does," Keach said. "It depends on low

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Math Dept

ABOVE Dr. Benjamin Webb

## New Faculty Spotlight: Benjamin Webb

The College of Physical and Mathematical Sciences welcomes Benjamin Webb, a visiting assistant professor in the Department of Mathematics.

Professor Webb received bachelor's degrees in mathematics and German at BYU and a minor in philosophy. He then earned a master's degree in mathematics at BYU before pursuing a PhD in mathematics at Georgia Tech. Upon recent completion of his PhD, he returned to BYU to teach calculus.

As an undergraduate student at BYU, Webb began participating in research and enjoyed unexpected surprises and moments of discovery.

"I like the surprises, like in math research," Webb said. "The things that come up that you don't expect, the structures you only guessed were there. And when you actually figure out what they are, it's really surprising what the answer turns out to be because it's usually not what you expected."

Webb is currently studying dynamical systems, specifically how a system's

structure influences its dynamics. Most recently this has involved studying the dynamics of different networks, such as how to synchronize networks of lasers.

While he is here at BYU, Webb is excited to gain new insights from faculty in different departments who have conducted similar research in their disciplines of expertise. He is also looking forward to involving students in undergraduate research in the future.

"We're always trying to expand the radius of what we know and when we do that more interesting questions come up," Webb said. "We just don't have the time to do it all by ourselves. It's great to have students."

In his free time, Webb enjoys playing the drums, skateboarding and snowboarding in the Utah snow. He was married when he was an undergraduate at BYU to Rebekah Ellermeier and now has two daughters and two sons.

by: Chris Scheitinger

## Nauvoo continued from page 1

moisture content. Nauvoo has been in a drought since about July. They're praying for rain, and we're praying that it doesn't rain."

By using GPR, the team was able to identify objects and structures buried under modern-day Nauvoo. Normally, GPR is used to give a two-dimensional view into the subsurface, but McBride and Keach used a multi-grid system that provided a three-dimensional view of structures underground. With this information, they could make educated decisions about where old structures and foundations were located underground.

"The primary goal of the project was to see if GPR would work in Nauvoo and under what conditions, so that we then would be in a position to advise . . . either church on what would be the best strategy for non-invasive archaeological study," said McBride. "And then

they can decide if they want to expand to do a full-scale study."

The two professors were grateful to all the different collaborators and participants who helped make the group project possible. The Community of Christ invited Keach and McBride to come back to Nauvoo next summer to evaluate even more sites. Keach and McBride agree that this was a large step towards helping the Community of Christ and The Church of Jesus Christ of Latter-day Saints collaborate together in new ways.

"The most important thing is that it provides collaboration with the Community of Christ, which is exciting because we have a shared heritage with them," McBride said. "Wouldn't it be great if we could find a way to move a little closer to acknowledge that shared experience?"

by: Jenny Spencer

## Dates to Remember

### SRC Abstract Submissions

<http://src.byu.edu>

Monday, Jan. 16 through midnight,  
Friday, Feb. 24

### Izatt-Christensen Lecture

General lecture: Tuesday, Feb. 7, 4  
p.m., WCS Varsity Theater

Technical lecture: Wednesday, Feb. 8,  
4 p.m., W112 BNSN



Chem Dept

ABOVE Dr. Scott Burt

## NMR Lab Helps Teach Molecular Structures

Who knew that BYU students had access to magnetic forces 220,000 times stronger than the magnetic field of the earth?

The Nuclear Magnetic Resonance (NMR) facility in the Department of Chemistry and Biochemistry allows undergraduate and graduate students to identify and analyze the shape of molecules.

As manager of the NMR facility, Dr. Scott Burt maintains the NMR instruments, teaches courses that emphasize NMR and trains research students who use NMR in their research. Burt also helps faculty and students apply advanced NMR techniques to research problems in addition to helping them operate the three high-field superconducting NMR instruments.

Students use both two-dimensional and one-dimensional NMR to analyze the structure of a molecule. With two-dimensional NMR, molecular data is plotted on two frequency axes and yields more accurate results compared to one-dimensional NMR.

"To have superconducting instruments that can do two-dimensional NMR, that are full-blown research instruments – that's a great opportunity for our undergraduates to be learning two-dimensional NMR, one-dimensional NMR and using this to solve real problems," Burt said.

Burt recently assisted Biology Department professors who had isolated a molecule from a plant that showed exciting anti-viral behavior. The identity of this molecule was unknown, so Burt conducted different NMR experiments, analyzed the data and determined the structure of this novel molecule.

"Now they know what the molecule looks like," Burt said. "That's really the

power of NMR. . . ."

Nuclear Magnetic Resonance uses the same physics as MRI scanners and is important when conducting research in synthetic and organic chemistry. Radiologists use MRI images to visualize the structure of the brain, cartilage and fluids in the human body. Similarly, chemists interpret NMR spectra to determine the arrangement of atoms in a molecule.

When organic and synthetic chemists attempt to make interesting molecules, NMR allows them to validate the structure of a molecule and determine which atoms are connected to one another.

"The reason NMR is so powerful is it lets you look at connectivities," Burt said. "By verifying these connectivities, you can say, 'This is the molecule we have and not any of these other ones.'"

The NMR lab is an indispensable resource to both faculty and students. NMR experiments can be very sophisticated, but once students are trained to interpret the data, it is a fairly straightforward process.

Many schools are unable to provide undergraduate students access to high-field NMR instruments. BYU, on the other hand, has several undergraduate labs that make routine use of the NMR facility, and undergraduate research students have full access to the lab. This gives students valuable research experience while preparing them for future schooling and careers.

"It's vital to our undergraduate teaching, and it's vital to our undergraduate and graduate research," Burt said. "At least one-fourth of our faculty would not be able to do the research they're doing if we did not have this equipment."

by: Chris Scheitinger

## Zare continued from page 1

ink: I use a pencil and eraser, and you have to be able to do the same thing with a lot of problems."

On Wednesday, Feb. 8, Zare will also give a more technical lecture titled "Searching for Short Lived Intermediates in Liquid Chemical Reactions." Part of Zare's research has focused on identifying the low-concentration molecules that quickly form and disappear during chemical reactions.

He will explain a new technique that uses mass spectrometry to identify these

intermediates in solution chemistry. All interested parties, especially chemistry students and professors, are invited to attend.

Dr. Zare's general lecture will be held at 4 p.m. on Feb. 7 in the Varsity Theater of the Wilkinson Student Center at BYU. His technical lecture will be at 4 p.m. on Feb. 8 in room W112 of the Ezra Taft Benson building, also at BYU. For more information, please contact Peggy Erickson at 801-422-6269 or by email at pbericks@chem.byu.edu.

by: Erik Westesen

# College Publications

## Chemistry and Biochemistry

C. Ellis, [D. Ess](#), "Computational Study on the Mechanism and Selectivity of C-H Bond Activation and Dehydrogenative Functionalization in the Synthesis of Rhazinilam", *Journal of Organic Chemistry*, 2011, volume 76/issue 17, pp. 7180-85

[D. Henderson](#), S. Lamperski, Z. Jin, J. Wu, "Density Functional Study of the Electrical Double Layer Formed by a High Density Electrolyte", *Journal of Physical Chemistry B*, 2011, volume 115/issue 44, 12911-14

R. Hilton, N. Andros, [R. Watt](#), "The Ferritin Center is Essential for Ferritin Iron Loading in the Presence of Phosphate and Minimizes Side Reactions that Form Fe(III)-phosphate Colloids", *Biometals*, 2011, online

D. Jensen, V. Gupta, R. Olsen, A. Miller, [R. Davis](#), [D. Ess](#), Z. Zhu, M. Vail, A. Dadson, [M. Linford](#), "Functionalization/Passivation of Porous Graphitic Carbon with Di-tert-amylperoxide", *Journal of Chromatography A*, 2011, volume 1218/issue 46, pp. 8362-69

T. Nagy, [D. Henderson](#), D. Boda, "Simulation of an Electrical Double Layer with a Low Dielectric Double Layer Between the Electrode and the Electrolyte", *Journal of Physical Chemistry B*, 2011, volume 115/issue 39, 11409-19

R. Orihuela, B. Fernandez, O. Palacios, E. Valero, S. Atrian, [R. Watt](#), J. Dominguez-Vera, M. Capdevila, "Ferritin and Metallothionein: Dangerous Liaisons", *Chemical Communications*, 2011, volume 47/issue 44, 12155-57

L. Pei, G. Jiang, L. Baxter, [M. Linford](#), "Analysis of Coal by Static Time-of-Flight Secondary Ion Mass Spectrometry (TOF-SIMS)", *American Vacuum Society*, 2011, volume 17/issue 1, pp. 67

[J. Price](#), E. Powers, J. Kelly, "N-PEGylation of a Reverse Turn is Stabilizing in Multiple Sequence Contexts, unlike N-GlcNAcylation", *ACS Chemical Biology*, 2011, volume 6/issue 11, pp. 1188-92

[J. Price](#), D. Powers, E. Powers, J. Kelly, "Glycosylation of the Enhanced Aromatic Sequon is Similarly Stabilizing in Three Distinct Reverse Turn Contexts", *PNAS*, 2011, volume 108/issue 34, pp. 14127-32

A. Saxena, S. Karumanchi, S. Fan, G. Horowitz, N. Hollenberg, [S. Graves](#), E. Seely, "Correlation of Cystatin-C with Glomerular Filtration Rate by Insulin Clearance in Pregnancy", *PubMed*, 2012, volume 31/issue 1, pp. 22-30

P. Stewart, L. Rodriguez, [D. Ess](#), "Electron Correlation and the Stability of Substituted Alkenes", *Journal of Physical Organic Chemistry*, 2011, volume 24/issue 12, 1222-28

J. Wu, J. Tao, D. Jiang, Z. Jin, [D. Henderson](#), "A Classical Density Functional Theory for Interfacial Layering of Ionic Liquids", *Soft Matter*, 2011, volume 7/issue 23, 11222-31

J. Xuan, M. Hamblin, J. Stout, [H. Tolley](#), R. Maynes, [A. Woolley](#), A. Hawkins, [M. Lee](#), "Surfactant Addition and Alternating Current Electrophoretic Oscillation during Size Fractionation of Nanoparticles in Channels with Two or Three Different Height Segments", *Journal of Chromatography A*, 2011, volume 1218/issue 50, 9102-10

## Computer Science

[D. Embley](#), W. Mok, "Mapping Conceptual Models to Database Schemas", *The Handbook of Conceptual Modeling: Theory, Practice, and Research Challenges*, 2011, pp. 41

## Mathematics

[L. Bakker](#), [T. Ouyang](#), D. Yan, S. Simmons, "Existence and Stability of Symmetric Periodic Simultaneous Binary Collision Orbits in the Planar Pairwise Symmetric Four-Body Problem", *Celestial Mechanics and Dynamical Astronomy*, 2011, volume 110/issue 3, pp. 271-90

[J. Cannon](#), W. Floyd, "What is Thompson's Group?", *Notices of the AMS*, 2011, volume 58/issue 8, pp. 2-4

[D. Cardon](#), B. Tuckfield, "The Jordan Canonical Form for a Class of Zero-One Matrices", *Linear Algebra and its Applications*, 2011, volume 435/issue 11, pp. 2942-54

[J. Purcell](#), "An Introduction to Fully Augmented Links", *Contemporary Mathematics*, 2011, volume 541, pp. 205-20

## Mathematics Education

R. Meylani, [D. Teuscher](#), "Calculus Readiness: Comparing Student Outcomes from Traditional Precalculus and AP Calculus AB with a Novel Precalculus Program", *Proceedings of the Thirty-third Annual Conference of the North American Chapter of the International Group for the Psychology of Mathematics Education*, 2011

R. Meylani, [D. Teuscher](#), "Precalculus Concept Assessment: A Predictor of AP Calculus AB and BC scores", *Proceedings of the Thirty-third Annual Conference of the North American Chapter of the International Group for the Psychology of Mathematics Education*, 2011

R. Meylani, [D. Teuscher](#), "Using Neural Networks to Predict AP-Calculus Test Scores from PCA and ACT Mathematics Test Scores", *Proceedings of the Thirty-third Annual Conference of the North American Chapter of the International Group for the Psychology of Mathematics Education*, 2011

R. Meylani, [D. Teuscher](#), "Using Neural Networks to Predict AP-Calculus Test Scores from PCA and ACT Mathematics Test Scores", *Proceedings of the Thirty-third Annual Conference of the North American Chapter of the International Group for the Psychology of Mathematics Education*, 2011

## Physics and Astronomy

D. Jensen, V. Gupta, R. Olsen, A. Miller, [R. Davis](#), [D. Ess](#), Z. Zhu, M. Vail, A. Dadson, [M. Linford](#), "Functionalization/Passivation of Porous Graphitic Carbon with Di-tert-amylperoxide", *Journal of Chromatography A*, 2011, volume 1218/issue 46, pp. 8362-69

## Statistics

J. Xuan, M. Hamblin, J. Stout, [H. Tolley](#), R. Maynes, [A. Woolley](#), A. Hawkins, [M. Lee](#), "Surfactant Addition and Alternating Current Electrophoretic Oscillation during Size Fractionation of Nanoparticles in Channels with Two or Three Different Height Segments", *Journal of Chromatography A*, 2011, volume 1218/issue 50, 9102-10