Modeling Forum

Results of the 1997 Mathematical Contest in Modeling

Frank Giordano, MCM Director

COMAP, Inc.
57 Bedford St., Suite 210
Lexington, MA 02173
f.giordano@mail.comap.com

Introduction

A total of 409 teams of undergraduates, from 226 schools, spent the second weekend in February working on applied mathematics problems. They were part of the twelfth Mathematical Contest in Modeling (MCM). On Friday morning, the MCM faculty advisor opened a packet and presented each team of three students with a choice of one of two problems. After a weekend of hard work, typed solution papers were mailed to COMAP on Monday. Nine of the top papers appear in this issue of *The UMAP Journal*.

Results and winning papers from the first twelve contests were published in special issues of *Mathematical Modeling* (1985–1987) and *The UMAP Journal* (1985–1996). The 1994 volume of *Tools for Teaching*, commemorating the tenth anniversary of the contest, contains all of the 20 problems used in the first ten years of the contest and a winning paper for each. Limited quantities of that volume and of the special MCM issues of the *Journal* for the last few years are available from COMAP.

Problem A: The Velociraptor Problem

The velociraptor, *Velociraptor mongoliensis*, was a predatory dinosaur that lived during the late Cretaceous period, approximately 75 million years ago. Paleontologists think that it was a very tenacious hunter and may have hunted

---

in pairs or larger packs. Unfortunately, there is no way to observe its hunting behavior in the wild, as can be done with modern mammalian predators. A group of paleontologists has approached your team and asked for help in modeling the hunting behavior of the velociraptor. They hope to compare your results with field data reported by biologists studying the behaviors of lions, tigers, and similar predatory animals.

The average adult velociraptor was 3 m long with a hip height of 0.5 m and an approximate mass of 45 kg. It is estimated that the animal could run extremely fast, at speeds of 60 km/hr, for about 15 sec. After the initial burst of speed, the animal needed to stop and recover from a buildup of lactic acid in its muscles.

Suppose that velociraptor preyed on *Thescelosaurus neglectus,* a herbivorous biped approximately the same size as the velociraptor. A biomechanical analysis of a fossilized thescelosaurus indicates that it could run at a speed of about 50 km/hr for long periods of time.

Part 1
Assuming the velociraptor is a solitary hunter, design a mathematical model that describes a hunting strategy for a single velociraptor stalking and chasing a single thescelosaurus as well as the evasive strategy of the prey. Assume that the thescelosaurus can always detect the velociraptor when it comes within 15 m, but may detect the predator at even greater ranges (up to 50 m) depending upon the habitat and weather conditions. Additionally, due to its physical structure and strength, the velociraptor has a limited turning radius when running at full speed. This radius is estimated to be three times the animal's hip height. On the other hand, the thescelosaurus is extremely agile and has a turning radius of 0.5 m.

Part 2
Assuming more realistically that the velociraptor hunted in pairs, design a new model that describes a hunting strategy for two velociraptors stalking and chasing a single thescelosaurus as well as the evasive strategy of the prey. Use the other assumptions and limitations given in Part 1.

Problem B: Mix Well For Fruitful Discussions

Small group meetings for the discussion of important issues, particularly long-range planning, are gaining popularity. It is believed that large groups discourage productive discussion and that a dominant personality will usually control and direct the discussion. Thus, in corporate board meetings, the board will meet in small groups to discuss issues before meeting as a whole. These smaller groups still run the risk of control by a dominant personality. In an

attempt to reduce this danger, it is common to schedule several sessions with a different mix of people in each group.

A meeting of An Tostal Corporation will be attended by 29 board members of which nine are in-house members (i.e., corporate employees). The meeting is to be an all-day affair with three sessions scheduled for the morning and four for the afternoon. Each session will take 45 minutes, beginning on the hour from 9:00 A.M. to 4:00 P.M., with lunch scheduled at noon. Each morning session will consist of six discussion groups with each discussion group led by one of the corporation's six senior officers. None of these officers is a board member. Thus, each senior officer will lead three different discussion groups. The senior officers will not be involved in the afternoon sessions, and each of these sessions will consist of only four different discussion groups.

The president of the corporation wants a list of board-member assignments to discussion groups for each of the seven sessions. The assignments should achieve as much of a mix of the members as possible. The ideal assignment would have each board member with each other board member in a discussion group the same number of times while minimizing common membership of groups for the different sessions. The assignments should also satisfy the following criteria:

1. For the morning sessions, no board member should be in the same senior officer's discussion group twice.

2. No discussion group should contain a disproportionate number of in-house members.

Give a list of assignments for members 1–9 and 10–29 and officers 1–6. Indicate how well the criteria in the previous paragraphs are met. Since it is possible that some board members will cancel at the last minute or that some not scheduled will show up, an algorithm that the secretary could use to adjust the assignments with an hour's notice would be appreciated. It would be ideal if the algorithm could also be used to make assignments for future meetings involving different levels of participation for each type of attendee.

The Results

The solution papers were coded at COMAP headquarters so that names and affiliations of the authors would be unknown to the judges. Each paper was then read preliminarily by two "triage" judges at Southern Connecticut State University (Problem A) or at Carroll College, Montana (Problem B). At the triage stage, the summary and overall organization are the basis for judging a paper. If the judges' scores diverged for a paper, the judges conferred; if they still did not agree on a score, a third judge evaluated the paper.

Final judging took place at Harvey Mudd College, Claremont, California. The judges classified the papers as follows:

	Outstanding	Meritorious	Honorable Mention	Successful Participation	Total
Velociraptor	5	37	58	134	234
Discussion Groups	4	25	43	103	175
	9	62	101	237	409

The nine papers that the judges designated as Outstanding appear in this special issue of *The UMAP Journal*, together with commentaries. We list those teams and the Meritorious teams (and advisors) below; the list of all participating schools, advisors, and results is in the **Appendix**.

Outstanding Teams

Institution and Advisor	Team Members

Velociraptor Papers

"Pursuit–Evasion Games in the Late Cretaceous"
Calvin College
Grand Rapids, MI
Gary W. Talsma

Edward L. Hamilton
Shawn A. Menninga
David Tong

"The Geometry and the Game Theory of
    Chases"
Harvard University
Cambridge, MA
Howard Georgi

Charlene S. Ahn
Edward Boas
Benjamin Rahn

"Gone Huntin': Modeling Optimal
    Predator and Prey Strategies"
Pomona College
Claremont, CA
Richard Elderkin

Hei (Celia) Chan
Robert A. Moody
David Young

"Lunch on the Run"
University of Alaska Fairbanks
Fairbanks, AK
John P. Lambert

Gordon Bower
Orion Lawler
James Long

"A Three-Phase Model for
    Predator–Prey Analysis"
Washington University
St. Louis, MO
Hiro Mukai

Lance Finney
Jade Vinson
Derek Zaba

Discussion Groups Papers

"An Assignment Model for
    Fruitful Discussions"

East China Univ. of Science and Technology	Han Cao
Shanghai, China	Hui Yang
Lu Xiwen	Zheng Shi

"Using Simulated Annealing to Solve
    the Discussion Groups Problem"

Macalester College	David Castro
St. Paul, MN	John Renze
Karla V. Ballman	Nicholas Weininger

"Meetings, Bloody Meetings!"

Rose-Hulman Institute of Technology	Joshua M. Horstman
Terre Haute, IN	Jamie Kawabata
Aaron D. Klebanoff	James C. Moore, IV

"A Greedy Algorithm for Solving
    Meeting Mixing Problems"

University of Toronto	Adrian Corduneanu
Toronto, Ontario, Canada	Cyrus C. Hsia
Nicholas A. Derzko	Ryan O'Donnell

Meritorious Teams

Velociraptor Papers (37 teams)
Beijing Univ. of Aeronautics and Astronautics, Beijing, China (Li Weiguo)
Brandon University, Brandon, Manitoba, Canada (Doug Pickering)
California Polytechnic State Univ., San Luis Obispo, CA (Thomas O'Neil) (two teams)
Dalian University of Technology, Dalian, Liaoning, China (He Ming-Feng)
Duke University, Durham, NC (David P. Kraines)
East China Univ. of Science and Technology, Shanghai, China (Shao Nianci)
Experimental High School of Beijing, China (Zhang Jilin)
Goucher College, Baltimore, MD (Megan Deeney)
Harvey Mudd College, Claremont, CA (David L. Bosley)
Hebei Institute of Technology, Tangshan, Hegei, China (Wan Xinghuo)
Hope College, Holland, MI (Ronald Van Iwaarden)
Macalester College, St. Paul, MN, (Daniel A. Schwalbe)
N.C. School of Science and Mathematics, Durham, NC (Dot Doyle)
Nankai University, Tianjin, China (Ruan Jishou)
National Univ. of Defence Technology, Chang Sha, Hunan, China (Cheng LiZhi)
North Carolina State University, Raleigh, NC (Robert T. Ramsay)
Rose-Hulman Inst. of Technology, Terre Haute, IN (George Berzsenyi)
Seattle Pacific University, Seattle, WA (Steven D. Johnson)

Southeast University, Nanjing, Jiangsu, China (Xu Liang)
Swarthmore College, Swarthmore, PA (Stephen B. Maurer)
Trinity University, San Antonio, TX (Diane G. Saphire)
Tsinghua University, Beijing, China (Wang Siqun)
United States Air Force Academy, USAF Academy, CO (Scott G. Frickenstein)
Univ. of Science and Technology of China, Hefei, Anhui, China, (Yu Feng)
Univ. of Science and Technology of China, Hefei, Anhui, China (Yu Tianyue)
University of Colorado, Boulder, CO (Anne M. Dougherty)
University of Puget Sound, Tacoma, WA (Robert A. Beezer)
University of Saskatchewan, Saskatoon, Canada (Raj Srinivasan)
Wake Forest University, Winston-Salem, NC (Stephen B. Robinson)
Wake Forest University, Winston-Salem, NC (Edward Allen)
Washington University, St. Louis, MO (Hiro Mukai)
Western Washington University, Bellingham, WA (Igor Averbakh)
Western Washington University, Bellingham, WA (Saim Ural)
Wuhan Univ. of Hydraulics and Engineering, Wuhan, Hubei, China (Peng Zhuzeng)
Youngstown State University, Youngstown, OH (J. Douglas Faires)
Zhejiang University, Hangzhou, China (Fang Daoyuan)

Discussion Groups Papers (25 teams)
Colorado College, Colorado Springs, CO (Deborah P. Levinson)
David Lipscomb University, Nashville, TN (Gary C. Hall)
Eastern Mennonite University, Harrisonburg, VA (John L. Horst)
Eastern Oregon State College, LaGrande, OR (Holly S. Zullo)
Eastern Oregon State College, LaGrande, OR (Mark R. Parker)
Gettysburg College, Gettysburg, PA (James P. Fink)
Graceland College, Lamoni, IA (Ronald K. Smith)
Grinnell College, Grinnell, IA (Thomas L. Moore)
Harvey Mudd College, Claremont, CA (David L. Bosley)
Hebei Institute of Technology, Tangshan, Hegei, China (Liu Baoxiang)
Hiram College, Hiram, OH (Larry Becker)
Ithaca College, Ithaca, NY (James E. Conklin)
Kenyon College, Gambier, OH (Brian D. Jones)
National Univ. of Defence Technology, Chang Sha, Hunan, China (Wu MengDa)
Peking University, Beijing, China (Huang Sheng)
South China Univ. of Technology, Guangzhou, China (Hao Zhifeng)
Southeast University, Nanjing, Jiangsu, China (Zhu Dao-yuan)
Trinity College Dublin, Dublin, Ireland (Timothy G. Murphy)
Univ. of Northern Colorado, Greeley, CO (William W. Bosch)
University College Cork, Cork, Ireland (Martin Stynes)
University College Cork, Cork, Ireland (Gareth Thomas)
University of Colorado, Boulder, CO (Bengt Fornberg)
University of Richmond, Richmond, VA (James Davis)
University of Southern Queensland, Toowoomba, Queensland, Australia
     (Christopher J. Harman)
Xidian University, Xian, Shaanxi, China (Mao Yong-cai)

Awards and Contributions

Each participating MCM advisor and team member received a certificate signed by the Contest Director and the appropriate Head Judge.

INFORMS, the Institute for Operations Research and the Management Sciences, awarded to each member of two Outstanding teams a cash award and a three-year membership. The teams were from Calvin College (Velociraptor Problem) and Rose-Hulman Institute of Technology (Discussion Groups Problem). Moreover, INFORMS gave free one-year memberships to all members of Meritorious and Honorable Mention teams.

The Society for Industrial and Applied Mathematics (SIAM) designated one Outstanding team from each problem as a SIAM Winner. Each team member received a cash prize. The teams were from Washington University (Velociraptor Problem) and from University of Toronto (Discussion Groups Problem). Both teams presented their results at a special Minisymposium at the SIAM Annual Meeting at Stanford University in July.

The Mathematical Association of America (MAA) designated one Outstanding team from each problem as an MAA Winner. The teams were from from Harvard University (Velociraptor Problem) and Macalester College (Discussion Groups Problem). The Macalester team gave a presentation at a special session of MAA Mathfest in Atlanta, GA, in August.

Judging

Director
Frank R. Giordano, COMAP, Lexington, MA

Associate Directors
Chris Arney, Dept. of Mathematical Sciences, U.S. Military Academy,
    West Point, NY
Robert L. Borrelli, Mathematics Dept., Harvey Mudd College,
    Claremont, CA
William Fox, Dept. of Mathematical Sciences, U.S. Military Academy,
    West Point, NY

Velociraptor Problem

Head Judge
Marvin S. Keener, Mathematics Dept., Oklahoma State University,
    Stillwater, OK

Associate Judges
James Case, Baltimore, Maryland
Alessandra Chiareli, Computational Science Center, 3M, St. Paul, MN

Courtney Coleman, Mathematics Dept., Harvey Mudd College,
    Claremont, CA
Patrick Driscoll, Dept. of Mathematical Sciences, U.S. Military Academy,
    West Point, NY
Ben A. Fusaro, Dept. of Mathematical Sciences,
    Florida State University, Tallahassee, FL
Mario Juncosa, RAND Corporation, Santa Monica, CA
    California State University Los Angeles, Los Angeles, CA
Mark Levinson, Edmonds, WA
Rick Mabry, Wolfram Research, Inc., Champaign, IL
Keith Miller, National Security Agency, Fort Meade, MD
Mike Moody, Mathematics Dept., Harvey Mudd College, Claremont, CA
Peter Olsen, National Security Agency, Fort Meade, MD
Jack Robertson, Mathematics Dept., Georgia College, Milledgeville, GA
John L. Scharf, Carroll College, Helena, MT
Lee Seitelman, Glastonbury, CT
Theodore H. Sweetser III, Jet Propulsion Lab, Pasadena, CA
Robert M. Tardiff, Dept. of Mathematical Sciences,
    Salisbury State University, Salisbury, MD
Beverly West, Cornell University, Ithaca, NY
Daniel Zwillinger, Zwillinger & Associates, Arlington, MA

Discussion Groups Problem

Head Judge
Maynard Thompson, Mathematics Dept., University of Indiana,
    Bloomington, IN

Associate Judges
Victor Adamchik, Wolfram Research, Inc., Champaign, IL
Karen Bolinger, Mathematics Dept., Arkansas State University,
    State University, AR
Jerry Griggs, University of South Carolina, Columbia, SC
John Kobza, Virginia Polytechnic Institute and State University,
    Blacksburg, VA
Daphne Liu, Dept. of Mathematics and Computer Science,
    California State University Los Angeles, Los Angeles, CA
Vijay Mehrotra, Onward Inc., Mountain View, CA
Veena Mendiratta, Lucent Technologies, Naperville, IL
Don Miller, Dept. of Mathematics, St. Mary's College, Notre Dame, IN
Cathy Roberts, Northern Arizona University, Flagstaff, AZ
Kathleen M. Shannon, Salisbury State University, Salisbury, MD
Michael Tortorella, Lucent Technologies, NJ
Marie Vanisko, Carroll College, Helena, MT

Triage Session

Velociraptor Problem

Head Triage Judge
Theresa M. Sandifer, Southern Connecticut State University, New Haven, CT

Associate Judges
Therese Bennett, Southern Connecticut State University, New Haven, CT
Susanna D. Fishel, Southern Connecticut State University, New Haven, CT
Ross B. Gingrich, Southern Connecticut State University, New Haven, CT
Cynthia B. Gubitose, Western Connecticut State University, Danbury, CT
C. Edward Sandifer, Western Connecticut State University, Danbury, CT
Xiaodi Wang, Western Connecticut State University, Danbury, CT

Discussion Groups Problem
(all judges from Carroll College, Helena, MT)

Head Triage Judge
Marie Vanisko

Associate Judges
Peter Biskis
Terence Mullen
Jack Oberweiser
Philip Rose

Sources of the Problems

The Velociraptor Problem was contributed by Jack Robertson, Mathematics Dept., and William Wall, Dept. of Biological and Environmental Sciences, both of Georgia College, Milledgeville, GA. The Discussion Groups Problem was contributed by Don Miller, Dept. of Mathematics and Computer Science, St. Mary's College, Notre Dame, IN.

Acknowledgments

Cautions

To the reader of research journals:

Usually a published paper has been presented to an audience, shown to colleagues, rewritten, checked by referees, revised, and edited by a journal editor. Each of the student papers here is the result of undergraduates working on a problem over a weekend; allowing substantial revision by the authors could give a false impression of accomplishment. So these papers are essentially au naturel. Light editing has taken place: minor errors have been corrected, wording has been altered for clarity or economy, and style has been adjusted to that of *The UMAP Journal*. Please peruse these student efforts in that context.

To the potential MCM Advisor:

It might be overpowering to encounter such output from a weekend of work by a small team of undergraduates, but these solution papers are highly atypical. A team that prepares and participates will have an enriching learning experience, independent of what any other team does.

Appendix: Successful Participants

KEY:

P = Successful Participation
H = Honorable Mention
M = Meritorious
O = Outstanding (published in this special issue)
A = Velociraptor Problem
B = Discussion Groups Problem

INSTITUTION	CITY	ADVISOR	A	B
ALABAMA				
University of Alabama	Huntsville	Boris Kunin		P
ALASKA				
Univ. of Alaska	Fairbanks	John P. Lambert	O,P	
ARIZONA				
Northern Arizona Univ.	Flagstaff	Terence R. Blows		P
University of Arizona	Tucson	Bruce J. Bayly	H	
CALIFORNIA				
Calif. Poly. State Univ.	San Luis Obispo	Thomas O'Neil	M,M	
Calif. State Univ.	Monterey Bay	Richard Brooks	P,P	
	Northridge	Gholam-Ali Zakeri	P	
Harvey Mudd College	Claremont	David L. Bosley	M	M
Humboldt State Univ.	Arcata	Mark Rizzardi	P	
Loyola Marymount Univ.	Los Angeles	Thomas M. Zachariah	P	
Pomona College	Claremont	Richard Elderkin	O	P
Sonoma State University	Rohnert Park	Clement E. Falbo		P
COLORADO				
Colorado College	Colorado Springs	Deborah P. Levinson		M
Trinidad State Jr. College	Trinidad	George E. Leone	P	
		Robert A. Philbin	P	
U.S. Air Force Academy	USAF Academy	Scott G. Frickenstein	M	
		Harry N. Newton		H
		Jonathan D. Robinson		H
University of Colorado	Boulder	Anne M. Dougherty	M	
		Bengt Fornberg		M
U. of Northern Colorado	Greeley	William W. Bosch		M,P
U. of Southern Colorado	Pueblo	Bruce N. Lundberg	P	

INSTITUTION	CITY	ADVISOR	A	B
CONNECTICUT				
Southern Conn. State U.	New Haven	Ross B. Gingrich	H	
University of Bridgeport	Bridgeport	Natalia Romalis		P
Western Conn. State U.	Danbury	Edward Sandifer		H
DISTRICT OF COLUMBIA				
Georgetown University	Washington	Andrew Vogt	P	P
George Washington Univ.	Washington	Daniel H. Ullman	P	P
Trinity College	Washington	Suzanne E. Sands	P	P
FLORIDA				
Florida Southern College	Lakeland	William G. Albrecht	P	
Florida State University	Tallahassee	Hong Wen	H	
Jacksonville University	Jacksonville	Robert A. Hollister	H	P
		D. Neal Boehmke	P	
Stetson University	Deland	Lisa O. Coulter	P	P
Univ. of North Florida	Jacksonville	Peter A. Braza	H	
GEORGIA				
Georgia College & State U.	Milledgeville	Craig Turner	P	P
Wesleyan College	Macon	Joseph A. Iskra		P
IDAHO				
Boise State University	Boise	Alan R. Hausrath	H	
ILLINOIS				
Illinois College	Jacksonville	Darrell E. Allgaier	P	
Illinois Wesleyan Univ.	Bloomington	Zahia Drici	P	
Northern Illinois Univ.	DeKalb	Linda R. Sons		H
Olivet Nazarene Univ.	Bourbonnais	Dale K. Hathaway	P	
Wheaton College	Wheaton	Paul Isihara	P	
INDIANA				
DePauw University	Greencastle	Richard Smock		P,P
Indiana University	Bloomington	Daniel P. Maki	P	
	South Bend	Morteza Shafii-Mousavi	P	H
Rose-Hulman Inst. of Tech.	Terre Haute	Aaron D. Klebanoff		O
		George Berzsenyi	M	
		Frank Young	P	
Saint Mary's College	Notre Dame	Joanne Snow	P	H
Valparaiso University	Valparaiso	Rick Gillman		H,P
Wabash College	Crawfordsville	Esteban Poffald		P,P

INSTITUTION	CITY	ADVISOR	A	B
IOWA				
Drake University	Des Moines	Alexander F. Kleiner		P
Graceland College	Lamoni	Ronald K. Smith		M
Grinnell College	Grinnell	Thomas L. Moore		M
Luther College	Decorah	Ruth Berger	H	
Mt. Mercy College	Cedar Rapids	Kent Knopp	P	
Simpson College	Indianola	Christopher Smith	P	
		Murphy Waggoner		P
Wartburg College	Waverly	Lynn J. Olson	P	
KENTUCKY				
Asbury College	Wilmore	Kenneth P. Rietz	P	
Georgetown College	Georgetown	Ann C. Heard		P
LOUISIANA				
McKinley High School	Baton Rouge	David Branton		P
McNeese State Univ.	Lake Charles	Robert L. Doucette		P
Northwestern St. Univ.	Natchitoches	Lisa R. Galminas	P	
MAINE				
Bowdoin College	Brunswick	Adam B. Levy	P	
Colby College	Waterville	Jan Holly	P	
University of Maine	Orono	Grattan P. Murphy		P
MARYLAND				
Goucher College	Baltimore	Megan Deeney	M	
Hood College	Frederick	John Boon		P
		Betty Mayfield	P,P	
Loyola College	Baltimore	Dipa Choudhury	P	H
		William D. Reddy	H	
Mt. St. Mary's College	Emmitsburg	Theresa A. Francis		H
		Fred J. Portier		P
Salisbury State University	Salisbury	Michael Bardzell		P
		Steven M. Hetzler		P
MASSACHUSETTS				
Harvard University	Cambridge	Howard Georgi	O	
Mass. Inst. of Technology	Cambridge	Gilbert Strang		P
Smith College	Northampton	Ruth Haas	P	P
Simon's Rock College	Great Barrington	Allen B. Altman	H,P	
Univ. of Massachusetts	Amherst	Edward A. Connors	P	P
		Kiwi Graham-Eagle		P
	Lowell	Lou Rossi		P

INSTITUTION	CITY	ADVISOR	A	B
Western New England Coll.	Springfield	Lorna Hanes	P	
MICHIGAN				
Calvin College	Grand Rapids	Gary Talsma	O	
Eastern Michigan Univ.	Ypsilanti	Christopher E. Hee	P	P
Hope College	Holland	Ronald Van Iwaarden	M	
Lawrence Tech. Univ.	Southfield	Ruth G. Favro		P
		Howard Whitston		P
Siena Heights College	Adrian	Rick Trujillo	P	
University of Michigan	Ann Arbor	Tava Olsen		P
MINNESOTA				
Gustavus Adolphus College	St. Peter	John M. Holte		P
Macalester College	St. Paul	Karla V. Ballman		O
		Daniel A. Schwalbe	M	
University of Minnesota	Duluth	Paul Boisen		P
		Zhuangyi Liu	P	
MISSOURI				
Missouri Southern St. Coll.	Joplin	Patrick Cassens	P,P	
Northwest Missouri St. U.	Maryville	Russell N. Euler	P	P
Rockhurst College	Kansas City	Paula Shorter	P	
Truman State University	Kirksville	Steve Smith	P	H
Washington University	St. Louis	Hiro Mukai	O,M	
Wentworth Military Acad.	Lexington	Charles Mordan	P	
MONTANTA				
Carroll College	Helena	Terence J. Mullen	P	
		Phil Rose	P	
		Anthony M. Szpilka	P	
NEBRASKA				
Hastings College	Hastings	David B. Cooke		H
Nebraska Wesleyan Univ.	Lincoln	P. Gavin LaRose		P,P
NEVADA				
Sierra Nevada College	Incline Village	Steve Ellsworth	P	
NEW JERSEY				
Camden County College	Blackwood	Penny L. Brower	P	
		Allison Sutton	P	

INSTITUTION	CITY	ADVISOR	A	B
NEW YORK				
Great Neck South H.S.	Great Neck	Albert Cavallaro	P	
Hofstra University	Hempstead	Raymond N. Greenwell	P	
Ithaca College	Ithaca	James E. Conklin	H	M
Nazareth College	Rochester	Nelson G. Rich		P
Queens College, CUNY	Flushing	Ari Gross	P	
St. Bonaventure Univ.	St. Bonaventure	Francis C. Leary	P	
		Albert G. White	P	
St. John Fisher College	Rochester	Daniel Cass	P	
U.S. Military Academy	West Point	Erik Bollt	H	
		Kellie Simon		H
Wells College	Aurora	Carol C. Shilepsky		P
Westchester Comm. Coll.	Valhalla	Neil Basescu	P	P
		Rowan Lindley	P,P	
Yeshiva College	New York	Yakov Karpishpan	P	
NORTH CAROLINA				
Appalachian State Univ.	Boone	Holly P. Hirst	H	
Duke University	Durham	David P. Kraines	M	
N.C. School of Science & Math.	Durham	Dot Doyle	M,H	
North Carolina St. Univ.	Raleigh	Robert T. Ramsay	M,P	
Univ. of North Carolina	Pembroke	Raymond E. Lee	P	
Wake Forest University	Winston-Salem	Edward Allen	M	
		Stephen B. Robinson	M	
Western Carolina Univ.	Cullowhee	Paul Brandt		H
		Jeff A. Graham	P	
OHIO				
College of Wooster	Wooster	Matt Brahm	H	
Hiram College	Hiram	Larry Becker		M
		James R. Case		P
		Brad Gubser	H	
Kenyon College	Gambier	Brian D. Jones	P	M
Miami University	Oxford	Douglas E. Ward		P
University of Dayton	Dayton	Ralph C. Steinlage		P
Xavier University	Cincinnati	Theresa Bright		P
		Richard J. Pulskamp	H	
Youngstown St. Univ.	Youngstown	J. Douglas Faires	M	P
		Paul Mullins	H	H

INSTITUTION	CITY	ADVISOR	A	B
OKLAHOMA				
Oklahoma State Univ.	Stillwater	John E. Wolfe	H	H
Southeastern Okla. St. U.	Durant	John M. McArthur		P
		Karla Oty	P	
Southern Nazarene University	Bethany	Philip Crow		P
OREGON				
Eastern Oregon St. Coll.	LaGrande	Mark R. Parker		M
		Norris Preyer	H	H
		Holly S. Zullo		M
Lewis & Clark College	Portland	Robert W. Owens		H
Southern Oregon St. Coll.	Ashland	Kemble R. Yates		H
PENNSYLVANIA				
Allegheny College	Meadville	David L. Housman		P
Bucknell University	Lewisburg	David Farmer		P
		Sally Koutsoliotas	H	
Chatham College	Pittsburgh	Jonathan Aronson		P
		Angela A. Fishman	P	
Gannon University	Erie	Rafal F. Ablamowicz	P	
		Thomas M. McDonald		P
Gettysburg College	Gettysburg	James P. Fink	H	M
Lafayette College	Easton	Thomas Hill	H	
Messiah College	Grantham	Douglas C. Phillippy		P
		Lamarr C. Widmer		P
Penn State Berks Campus	Reading	Leila Miller-Van Wieren		P
		Douglas M. Van Wieren	P	
Swarthmore College	Swarthmore	Stephen B. Maurer	M	
SOUTH CAROLINA				
Charleston Southern Univ.	Charleston	Jeryl Jouhson		P
The Citadel	Charleston	Kanat Durgun	P	
Coastal Carolina Univ.	Conway	Prashant S. Sansgiry	P	
Columbia College	Columbia	Scott A. Smith		P
Francis Marion University	Florence	Catherine A. Abbott		P
Midlands Technical College	Columbia	Richard Bailey	P	
		John R. Long	P	
SOUTH DAKOTA				
Northern State University	Aberdeen	A.S. Elkhader		P

INSTITUTION	CITY	ADVISOR	A	B
TENNESSEE				
Austin Peay St. Univ.	Clarksville	Mark C. Ginn	P	P
Christian Brothers University	Memphis	Cathy W. Carter	P	P
David Lipscomb Univ.	Nashville	Gary C. Hall		M
		Mark A. Miller	P	
TEXAS				
Abilene Christian Univ.	Abilene	David Hendricks	P	
Rice University	Houston	Douglas W. Moore	P	
Southwestern University	Georgetown	Therese N. Shelton		P
Trinity University	San Antonio	Diane G. Saphire	M,P	
University of Houston	Houston	Barbara Lee Keyfitz	P	
University of Texas at Austin	Austin	Mike Oehrtman	H	H
U. of Texas–Pan American	Edinburg	Roger A. Knobel	P	P
UTAH				
University of Utah	Salt Lake City	Chris Johnson	P	
		Don H. Tucker	P,P	
Utah State University	Logan	Michael C. Minnotte	P	
VERMONT				
Johnson State College	Johnson	Glenn D. Sproul	H,P	
Norwich University	Northfield	Leonard C. Gambler		P
VIRGINIA				
College of William & Mary	Williamsburg	Larry M. Leemis		H
Eastern Mennonite Univ.	Harrisonburg	John L. Horst		M
James Madison Univ.	Harrisonburg	James S. Sochacki	H	
Roanoke College	Salem	Chris Lee	P	
		Roland B. Minton	P	
Thomas Jefferson H.S. for Science & Technology	Alexandria	Patricia Gabriel	P	
University of Richmond	Richmond	James Davis		M
Virginia Western Comm. Coll.	Roanoke	Ruth Sherman	P	P
WASHINGTON				
Pacific Lutheran Univ.	Tacoma	Rachid Benkhalti		P
Seattle Pacific University	Seattle	Steven D. Johnson	M	
Univ. of Puget Sound	Tacoma	Robert A. Beezer	M	
		Perry Fizzano		H
		Martin Jackson	P	
		John Riegsecker		P

INSTITUTION	CITY	ADVISOR	A	B
Western Washington U.	Bellingham	Igor Averbakh	M	H
		Saim Ural	M	P
WISCONSIN				
Beloit College	Beloit	Paul J. Campbell		P,P
Carroll College	Waukesha	Dennis Mick	P	
		John Symms	P	
Edgewood College	Madison	Ken Jewell		P
		Steven Post		P
Northcentral Tech. Coll.	Wausau	Frank J. Fernandes		P
		Robert J. Henning		P
Ripon College	Ripon	Robert Fraga	P	P
Univ. of Wisconsin	Platteville	Clement T. Jeske		P
		John A. Krogman	P	
		Sheryl Wills	P	
		Sheela Yadav-Onley	P	
	Stevens Point	Norm D. Curet		P
Wisc. Lutheran Coll.	Milwaukee	Marvin C. Papenfuss	H	
AUSTRALIA				
U. of South Queensland	Toowoomba, Qld.	Christopher J. Harman		M
		Tony Roberts	H	
CANADA				
Brandon University	Brandon, Man.	Doug Pickering	M	
Earl Haig Secondary Schl	North York, Ont.	John Caranci	P	P
Memorial U. of Nfld	St. John's, Nfld.	Andy Foster	P	
University of Calgary	Calgary, Alb.	David R. Westbrook	P,P	
Univ. of Saskatchewan	Saskatoon, Sask.	James A. Brooke	H	
		Raj Srinivasan	M	
University of Toronto	Toronto, Ont.	Nicholas A. Derzko	P	O
Univ. of Western Ontario	London, Ont.	Peter H. Poole		H
York University	North York, Ont.	Neal Madras	P,P	
		Anthony Szeto	P,P	
CHINA				
Anhui University	Hefei, Anhui	Yang Shangjun		P
		Zeng Jianjun	P	
Beijing Inst. of Tech.	Beijing	Bao Zhu Guo	H	
		Cui Xiao Di	P	
Beijing Normal Univ.	Beijing	Zhang Jilin		H

INSTITUTION	CITY	ADVISOR	A	B
Beijing Union University	Beijing	Ren KaiLong	P	
		Wang Xinfeng	H	
		Zeng Qingli		P
Beijing Univ. of Aero.	Beijing	Li Weiguo	M	P
China Pharmaceutical Univ.	Nanjing	Qiu Jiaxue		P
		Yang Jinghua	P	
Chongqing University	Chongqing,	Li Fu	H	
	Sichuan	Gong Qu	H	
		He Zhongshi		P
		Liu Qiongsen	P	
Dalian Univ. of Technology	Dalian, Liaoning	Yu Hong-Quan		P
		He Ming-Feng	M	P
Da Tong High School	Shanghai	Gong Changan		H
E. China U. of Sci. & Tech.	Shanghai	Shao Nianci	M	
		Lu Xiwen		O,H
		Lu Yuanhong	H	
Experimental H.S. of Beijing	Beijing	Zhang Jilin	M	
Fudan University	Shanghai	Cao Yuan	H	
		Tan Yongji		H
		Liao You Wei	P	P
Harbin Inst. of Tech.	Harbin,	Shang Shouting	H,P	
	Heilongjiang	Wang Yong	H,H	
Hebei Institute of Tech.	Tangshan, Hegei	Liu Baoxiang		M
		Wan Xinghuo	M	
Huazhong U. of Sci. & Tech.	Wuhan, Hubei	Shi Bao-chang	P	
		Qi Huan		H
		Gao Jian		P
		He Nanzhong	P	
Info. & Eng'ng. Institute	Zhengzhou, Henan	Han Zhonggeng		H
Jilin Inst. of Technology	Changchun, Jilin	Dong Xiaogang	H	
		Gao Tian		P
		Sun Changchun		P
		Xu Yunhui	H	
Jilin University	Changchun, Jilin	Liu Qinghuai	P	
		Lu Xianrui	H	
		Ma Fuming	P	
		Xue Yin Jing	P	
Jilin University of Techn.	Changchun, Jilin	Zhang Kuiyuan		H
		Fange Peichen	H	
Jinan University	Guangzhou,	Fan Suohai		P,P
	Guangdong	Ye Shi Qi		P

INSTITUTION	CITY	ADVISOR	A	B
Nanjing U. of Sci. & Tech.	Nanjing, Jiangsu	Zhao Chong Gao	H	
Nankai University	Tianjin	Huang Wuqun	P	
		Ruan Jishou	M	
		Zhou XingWei	P	
National U. of Defence Tech.	Chang Sha, Hunan	Wu MengDa		M
		Cheng LiZhi	M	
Peking University	Beijing	Hu Xiaodong	P	H
		Huang Sheng	H	M
Shandong University	Beijing	Qu Chunjiang	P	
		Long Heping		H
		Yu Tiam		H
		Cui Yuquan	P	
Shanghai Jiaotong University	Shanghai	Chu Wensong	P	
		Chen Zhihe	P	
		Huang Jianguo	P	
		Zhou Gang		H
Shanghai Normal Univ.	Shanghai	Guo Shenghuan	H	H
South China Univ. of Tech.	Guangzhou, Guangdong	Zhu Fengfeng	H	
		Fu Hongzuo	H	
		Hao Zhifeng		M
		Chang Zhihua		H
Southeast University	Nanjing, Jiangsu	Huang Jun	H	
		Xu Liang	M	
		Sun Zhizhong		P
		Zhu Daoyuan		M
Southwest Jiaotong University	Chengdu, Sichuan	Deng Ping		P
		Li Tianrui	H	
		Yuan Jian		P
		Zhao Lianwen	P	
Tsinghua University	Beijing	Wang Siqun	M,H	
U. of Sci. & Tech. of China	Hefei, Anhui	Xue Jiangeng		H
		Yu Tianyue	M	
		Wang Xinmao		H
		Yu Feng	M	
Wuhan U. of Hydraulic & Engin.	Wuhan, Hubei	Peng Zhuzeng	M	
Xian Jiaotong University	Xian, Shaanxi	Dai YongHong	H	
		Dong Tianxin	H	
		He Xiaoliang		H
		Zhou Yicang	H	
Xidian University	Xian, Shaanxi	Hu Yupu	H	
		Li Youming		H
		Mao Yongcai		M

INSTITUTION	CITY	ADVISOR	A	B
Zhejiang University	Hangzhou	Fang Daoyuan	M	P
ZhengZhou Univ. of Tech.	ZhengZhou, Henan	Jia Junguo	H	
		Wang Shubin	H	
Zhongshan University	Guangzhou,	Tang Mengxi	H	
	Guangdong	Wang Yuan Shi		H
		Xu Liu Jun	P	
		Yu Jin Hua	P	

HONG KONG

Hong Kong Baptist Univ.	Kowloon Tong	Tong Chong Sze		H
		Shiu Wai Chee	P	

IRELAND

Trinity College Dublin	Dublin	Timothy G. Murphy	H	
		James C. Sexton		M
Univ. College Cork	Cork	Patrick Fitzpatrick	H	
		Martin Stynes		M
		Gareth Thomas		M
Univ. College Galway	Galway	Martin Meere		P
University of Limerick	Limerick	Gordon S. Lessells	P	P

LITHUANIA

Vilnius University	Vilnius	Ricardas Kudzma	P	
		Algirdas Zabulionis		H

SOUTH AFRICA

University of Stellenbosch	Stellenbosch	Thomas P. Dreyer	P	
		Juan Vuuren		P