

SENICER
SCIENCE EDUCATION FOR NEW CIVIC ENGAGEMENTS AND RESPONSIBILITIES

Building civic capacity by connecting the science of learning to the learning of science.

SENCER Midwest Center for
Innovation
2009 Fall Symposium

Teaching Quantitative Reasoning through Civic Issues

Nov. 6th & 7th, 2009

Metropolitan
State University 

Welcome Symposium Guests,

SENCER (Science Education for New Civic Engagements and Responsibilities) was initiated in 2001 under the National Science Foundation's CCLI national dissemination track. Since then, SENCER has established and supported an ever-growing community of faculty, students, academic leaders, and others to improve undergraduate STEM (science, technology, engineering and mathematics) education by connecting learning to critical civic questions. SENCER is the signature program of the National Center for Science and Civic Engagement, which was established in affiliation with Harrisburg University of Science and Technology.

SENCER's mission is to support the work of STEM faculty in making "meaningful changes" in their STEM courses and programs in order to: (1) get more students interested and engaged in learning within STEM courses, (2) help students connect STEM learning to their other studies, and (3) strengthen students' understanding of science and their capacity for responsible work and citizenship. Key findings from an extensive, independent, multi-year evaluation of the SENCER project show that the SENCER approach strengthens learning for women, minorities, and students who major in non-STEM fields, as well as those who have chosen to major in a STEM field.

The SENCER Center for Innovation - Midwest is a regionally distributed organization that offers programming and support for current members of the SENCER community and people new to SENCER. SCI-Midwest is designed to fulfill the needs of the community throughout the year on a local level and to offer symposia and workshops that complement national events, such as the annual SENCER Summer Institute (SSI) and the Washington DC Symposium and Capitol Hill Poster Session. The SCI-Midwest group has broad expertise among its members, but has a particular interest in public health issues, water quality in the Great Lakes region, teacher education, and math and civic engagement.

Teaching Quantitative Reasoning through Civic Issues is the first SCI-Midwest symposium hosted by Metropolitan State University in St. Paul, MN. With Metropolitan State University's unwavering commitment to civic engagement and the mathematics faculty's commitment to increasing student learning through engaged civic learning, Metropolitan State University was a natural choice to host this event. The goal of the symposium is to bring together faculty, students and community partners who are using civic issues to increase student engagement and learning in all disciplines which require quantitative reasoning skills.

November 2009

Special thanks to:

Science Education for New Civic Engagements and Responsibilities (SENCER)

SENCER Center for Innovation - Midwest

National Center for Science and Civic Engagement (NCSCE)

Metropolitan State University

Agenda

SENCER Midwest Center for Innovation Fall 2009 Symposium

FRIDAY, November 6, 2009

5:00 pm - 5:30 pm	Registration (New Main Great Hall)
5:30 pm - 6:00 pm	Opening Remarks - Cindy Kaus, Associate Professor of Mathematics, Metropolitan State University Welcome by President Sue Hammersmith , Metropolitan State University (Founders Hall Auditorium)
6:00 pm - 7:00 pm	Keynote Address: Deborah Hughes Hallett , Professor of Mathematics University of Arizona and Harvard University <i>Civic Judgments and Decisions: Harnessing the Power of Numbers</i> (Founders Hall Auditorium)
7:00 pm - 8:30 pm	Dinner Reception (New Main Great Hall)

SATURDAY, November 7, 2009

8:30 am - 9:30 am	Registration and Continental Breakfast (Founders Hall Reception Area)	
9:00 am - 9:30 am	Opening Remarks by David Burns, PI SENCER (Founders Hall Reception Area)	
9:30 am - 10:30 am	Plenary: Neil Lutsky, Professor of Psychology, Carleton College <i>What is Quantitative Reasoning? A Critical Thinking Account</i> (Founders Hall Auditorium)	
	Concurrent Sessions	
	New Main Lower Level 213	New Main Lower Level 215
10:45 am - 11:25 am	John Zobitz <i>Counting the Food-miles: How What You Eat Travels from Farm to Table</i>	Karen Saxe <i>Quantitative Approaches to Problems in Democracy</i>
11:25 am - 12:05 pm	Todd Lafrenz <i>Civic Engagement and Sustainable Campus/Community Activities in Chemistry: Addressing Student Attitudes and Attrition Through Engaged Learning</i>	Lynn Gieger <i>Talented College Women and the STEM Disciplines: What Role does Civic Engagement Play in Choosing a Major?</i>
12:15 pm - 1:00 pm	Lunch Break Remarks by Dennis Lehman, co-director of the SENCER Midwest Center of Innovation (Founders Hall Reception Area)	
	Concurrent Sessions	
	New Main Lower Level 213	New Main Lower Level 215
1:00 pm - 1:40 pm	Katalin Othmer <i>Which Civic Issue? Choosing a Civic Issue Through Which to Teach Quantitative Reasoning</i>	Milo Schield <i>Top Ten Questions for the Statistically Literate Citizens: QR Essentials for Civic Engagement</i>
1:40 pm - 2:20 pm	Robert Keller <i>Practical Mathematics: A Mathematics Practicum</i>	Paul Roback <i>Academic Civic Engagement in Introductory Statistics: What's the Downside?</i>
2:20 pm - 3:00 pm	Rikki Wagstrom <i>Integrating Sustainability Topics into Introductory-Level Mathematics Courses</i>	Daniel Kaplan <i>Those Confounded Civic Issues!</i>
3:15 pm - 3:45 pm	Poster Session Davida Alperin, Virginia Card, Sridevi Pudipeddi Coffee break (Founders Hall Reception Area)	
3:45 pm - 4:15 pm	Question and Answer Period; Brainstorming for the Future (Founders Hall Reception Area)	
4:15 pm - 4:30 pm	Closing and Evaluations (Founders Hall Reception Area)	

Keynote and Plenary Speaker Bios

Deborah Hughes Hallett is Professor of Mathematics at the University of Arizona and Adjunct Professor of Public Policy at the Harvard Kennedy School. With Andrew M. Gleason at Harvard, she organized the Calculus Consortium based at Harvard, which brought together faculty from a wide variety of schools to work on undergraduate curricular issues. She is regularly consulted on the design of curricula and pedagogy for undergraduate mathematics at the national and international level and she is an author of several college level mathematics texts. She has co-authored a report for the National Academy of Science's Committee on Advanced Study in American High Schools, and is a member of the MAA Committee on Mutual Concerns and the College Board's Committee to review the Math-SAT. In 1998 and 2002 she was co-chair of International Conference on the Teaching of Mathematics in Greece, attended by several hundred faculty from about 50 countries. In 2006, she chaired the third conference in this sequence in Istanbul, Turkey. She established programs for master's students at the Kennedy School of Government, precalculus, and quantitative reasoning courses (with Andy Gleason), and courses for economics majors. She was awarded the Louise Hay Prize and elected a fellow of the American Association for the Advancement of Science for contributions to mathematics education. Her work has been recognized by prizes from Harvard, the University of Arizona, and as national winner MAA Award for Distinguished Teaching.

Neil Lutsky Neil Lutsky is the William R. Kenan, Jr. Professor of Psychology at Carleton College. He was the founding director of Carleton's Quantitative Inquiry, Reasoning, and Knowledge (Quirk) Initiative, which has been supported by grants from the Department of Education, National Science Foundation, and Keck Foundation. Lutsky serves on the Board of Directors of the National Numeracy Network and as an Associate Editor of the NNN journal, Numeracy. He received his Ph.D. in Social Psychology from Harvard University, served as national president of the Society for the Teaching of Psychology, and is a recipient of the Walter Mink Award for outstanding teaching in psychology.

<http://serc.carleton.edu/quirk/>

Abstracts

Concurrent Sessions

Lynn Gieger

Oglethorpe University, Atlanta GA

11:25-12:05 NML215

Talented College Women and the STEM Disciplines: What Role does Civic Engagement Play in Choosing a Major?

This study addresses the question of what factors impact academically talented college women's choice of a major. The study was motivated by the extensive research literature concerning the small number of academically talented women who choose an undergraduate major in a STEM discipline as compared with academically talented men. Twelve academically talented college women from throughout the United States agreed to participate in a 12-week on-line focus group to explore the issue. All had considered a major in a STEM discipline, but only a handful had eventually chosen a STEM field as their major. The study found that four central factors influenced choice of major among the participants: environment, behavior, talent, and value. Value had the highest relative influence, as these women were deeply concerned about the positive social impact and civic relevance of their future careers. Many participants had conflicts with the perceived values of the STEM departments at their colleges and universities, and those conflicts were often cited as the central reason (and occasionally the only reason) that a participant was not majoring in a STEM field. In addition to the discussion of these findings, this presentation will also involve a discussion of how university STEM departments can use the findings to address the problem of female underrepresentation in the STEM disciplines.

Daniel Kaplan

Macalester College, St. Paul MN

2:20 - 3:00 NML215

Those Confounded Civic Issues! One of the difficulties in teaching with civic issues is to respect their complexity: multiple interacting factors that shape outcomes. Statisticians refer to the problem of "confounding," where additional variables play roles that color the perceived relationship between and outcome and an explanatory variable of primary interest. For example, in examining the relationship between health outcomes and expenditures, it's obviously important to consider confounding variables such as age, medical condition, etc. Unfortunately, the standard introductory-level quantitative STEM curriculum emphasizes relationships of only two variables, and conventional statistics courses can do little more than warn about the dangers of confounding, "lurking" variables, and Simpson's paradox. I'll show how to put confounding at the center of a statistics course by making the multivariate mathematics of confounding accessible to introductory students. What's key is to make statistics about modeling rather than means and proportions. Doing so makes clear to students the value of thinking about issues formally and quantitatively and gives them the modeling and interpretative tools they need to study systems of genuine complexity, be they civic or scientific.

The approaches that I will discuss are at the heart of the first-year quantitative curriculum at Macalester: Applied Calculus and Introduction to Statistical Modeling. More information about the statistical modeling part of the sequence is available at www.macalester.edu/~kaplan/ISM.

Robert Keller

Loras College, Dubuque IA

1:40 - 2:20 NML213

Practical Mathematics: A Mathematics Practicum A valuable opportunity to revise and reinvigorate an existing but uninspired Survey of Mathematics course arose when Loras College adopted a 3-week January term beginning in 2008. The new version of the course focuses on practical mathematics concepts taught via a series of daily case studies. The majority of these involve partnerships with local businesses and organizations in an important way.

The course was designed to meet several conditions. January term classes would need to incorporate experiential pedagogies throughout. Second, the course should satisfy the general education mathematics requirement. Case studies focus student learning on important mathematical content and put students in charge of their own learning. Students learn the necessary mathematics *as they go* using the textbook and internet resources; occasional short lectures supplemented these methods.

Each case study provides opportunities for students to practice real life skills they will likely use at home or perhaps in the workplace. For example, students competed to form the best new campus tour for admissions using concepts from graph theory. In another, students formed “families” and armed with all relevant information for their family, ascertained their credit worthiness and purchasing power and went through the mortgage pre-approval process with an area bank. Another day, they developed plans for a small business and applied for a loan with authentic application materials.

In this presentation, I will describe how the course was designed and provide examples of some case studies in detail. I will also share some rudimentary assessment data.

Todd Lafrenz

Metropolitan State University, St. Paul MN

11:25 - 12:05 NML213

Civic Engagement and Sustainable Campus/Community Activities in Chemistry: Addressing Student Attitudes and Attrition Through Engaged Learning

At the majority of campuses nationwide, attrition in freshman level general chemistry and sophomore level organic chemistry is a significant issue. Additionally, many students begin these sequences with negative impressions about the content or difficulty of these courses, and/or struggle in making connections with their personal lives or career plans. The presenter will share his experiences of incorporating civic engagement activities in these courses (both the challenges and successes), and share examples of how these activities resulted in students becoming more active learners, while increasing student involvement in campus and community sustainability initiatives. Examples will include student involvement in quantifying both individual and campus contributions to “carbon footprints,” and the data collected that has resulted in measurable impact and change.

Katalin Othmer

Marymount Manhattan College, New York NY

1:00 - 1:40 NML213

Which Civic Issue? Choosing a Civic Issue Through Which to Teach Quantitative Reasoning

Bringing civic issues into the quantitative reasoning classroom is a useful pedagogical strategy for maintaining the interest of students and helping students to be more engaged with their society. But how do you choose appropriate civic issues? This complex question makes many educators reluctant to connect learning in the classroom to topical community affairs, thereby missing out on a powerful tool for increasing student motivation and forming more engaged citizens. Common reasons for excluding such topics are a fear of controversy or conflict in the classroom and a fear of causing offence. By having students be involved in the choice of issues that are brought into the classroom in a systematic way, teachers can navigate class discussions away from potential hazards while enjoying the benefits of connecting the learning goals of the course to civic issues that students are interested in.

We present a strategy for choosing appropriate civic issues through which to teach quantitative reasoning that is mindful of the inherent pitfalls of bringing a possibly contentious community issue into a diverse classroom. This strategy involves a multi-step process that is primarily student-led within a framework put in place by the instructor. Civic issues are introduced in stages that initially run parallel to the mathematical learning goals of the course. The culmination of this strategy is the joining of these two strands in project-work that demonstrates quantitative literacy and the ability to communicate effectively using the language of mathematics about a civic issue of importance to the student. We will discuss this method for choosing civic issues and make recommendations based on its implementation in a quantitative reasoning course with a community-based learning (service-learning) component. This component of the course involved collaboration with an after-school program for middle-school students in a neighborhood with many new immigrants and economically diverse families. The civic issues investigated in the college-level quantitative reasoning class were used as themes around which to organize the math program run by the college students for the middle-school students. For this reason, the civic issues chosen had to be appropriate for both college and middle-school students, as well as be good vehicles for fostering quantitative literacy and reasoning. The framework presented for choosing civic issues to bring into the classroom can be implemented in the full spectrum of STEM courses, independently of whether or not there is a community-based learning component to the course.

Paul Roback

Saint Olaf College, Northfield MN

1:40 - 2:20 NML215

Academic Civic Engagement in Introductory Statistics: What's the Downside? Academic civic engagement (ACE) is defined as "course-based learning activities [including service learning] that engage the college in partnership with the community in which it is located". While it is hard to disagree with the powerful possibilities that projects incorporating ACE bring to an applied undergraduate course in statistics, nothing good comes for free. In order to successfully incorporate a semester-long ACE project that provides a valuable final product for the community partner, traditional project guidelines may need to be altered and traditional items from the class syllabus may need to be pruned. This talk will describe my experiences with ACE during an introductory class in statistics, including guidelines used, course topics sacrificed, reaction from students and community partners, and lessons learned for future implementations.

Karen Saxe

Macalester College, St. Paul MN

10:45 - 11:25 NML215

Quantitative Approaches to Problems in Democracy Last fall, twenty-four students took a class newly developed at Macalester College on the mathematics behind some of the basic problems of elections and voting. In this presentation, I will describe the course as taught last year, and ideas for further development of the course.

The course is intended for future political leaders, and most students are majors in political science, or international studies. The central topics of the course are the apportionment problem, the redistricting problem, and a study of electoral systems used around the world. The apportionment portion studies the well-known and fraught history of congressional reapportionment in this country, and also challenges faced by countries that use proportional representation as a way to fill parliaments or other national assemblies. Measures of compactness of proposed districts give a way of identifying fragrant gerrymandering, and districting algorithms are developed to determine not only political districts, but also public school districts. The last section of the course covered, as an example, how single-transferable voting (instant runoff voting if one seat to fill) works, and why it might be challenged in courts. Throughout the course, all is done in context, and pros and cons always debated. The hope is that with these new quantitative approaches in their arsenal, students can better assess arguments regarding the workings of democracies.

Milo Schield

Augsburg College, St. Paul MN

1:00 - 1:40 NML215

Top Ten Questions for the Statistically Literate Citizens: QR Essentials for Civic Engagement Statistical literacy is a new goal for statistical educators based on the ASA GAISE recommendations. Statistical literacy must be empirically based on the statistical needs of educated adults in a modern society. As such statistical literacy is needed by the 40% of college students in non-quantitative majors. A goal for SENCER is to "cultivate a basic understanding of science and mathematics in all educated people, and develop a paradigm of science education that prizes rigor and success," This paper focuses on reports in the media as the source of innumerable civic issues and presents ten questions that can and should be asked of every claim, graph, table or argument involving statistics. These ten questions are argued to be essential for all those who want to be statistically literate. The quantitative reasoning issues raised in these ten questions are essential for an informed civic engagement. An in-depth analysis of these ten questions may lead to a better understanding of important concepts that are conspicuously absent from introductory statistics course.

Rikki Wagstrom

Metropolitan State University, St. Paul MN

2:20 - 3:00 NML213

Integrating Sustainability Topics into Introductory-Level Mathematics Courses A pre-college algebra level course was taught with a curriculum using quantitative reasoning and mathematical modeling to motivate and apply linear, exponential and logarithmic functions. Students used their

quantitative reasoning, modeling and algebraic skills to quantitatively explore the sustainability of the U.S. agricultural system, ecological footprints and limited resource availability within the U.S. This presentation will also highlight the results from pre- and post-course assessments of student learning, interest in studying and using mathematics, and mathematical confidence level.

John Zobitz Augsburg College, St. Paul MN

10:45 - 11:25 NML213

Counting the Food-miles: How What You Eat Travels from Farm to Table What does it mean to eat locally or to be a “locavore”? This talk describes a module used with an introductory environmental studies class to quantitatively address food justice issues. The module learning objectives were to (a) understand the commerce and transport of food through supply chains, (b) apply life-cycle analyses to determine the total miles a meal travels from to your plate, and (c) determine greenhouse gas emissions associated with different types of food. To meet these objectives students kept a food journal, allowing them to analyze their contribution to greenhouse gas emissions. From their food journal students could quantitatively investigate (a) if a locally-grown diet had fewer greenhouse gas emissions than a conventional diet, (b) which aspects of their diet has the most emissions, and (c) what other lifestyle choices could have the same environmental impact (e.g. reduction in emissions) as a local diet. We will present the module and student reactions to the ensuing discussion.

Poster Presentations

David J. Alperin University of Wisconsin, River Falls WI

3:15 - 3:45 FH Rec

Applying Cross Tabulation Analysis Skills to Social Problems in the News Newspapers, magazines, and even informative websites use cross-tabulation tables (or variations of such tables) in their reporting. In schools, such tables are often used to help students start learning about how to analyze quantitative data. By providing students with an understanding of such tables, they can become more critical readers and gain a better understanding of societal issues that face us as citizens in our democracy. This poster will describe an assignment in which students, who have learned the basic skills of developing and interpreting cross-tabulation tables, are asked to apply that knowledge to a story about racial disparities in mortgage lending.

Virginia Card Metropolitan State University, St. Paul MN

3:15 - 3:45 FH Rec

Ecological Science and Civic Engagement: the Swede Hollow Park Oak Census and Big Tree Survey The Friends of Swede Hollow is a community group with a long-term interest in the natural and historic ecosystems of Swede Hollow Park, adjacent to the campus of Metropolitan State University. In this pair of summer research projects, funded by a grant from the Center for American Democracy to the Center for Community Based Learning of the University, two biology students answered ecological questions of interest to the community, in particular, how big and how old the “big trees” are, and the number, age, and species of the oaks. The students located, identified, measured and mapped every oak tree and every tree greater than 40cm in diameter. They found 169 oak trees in Swede Hollow, including 119 burr, 31 red, 10 pin and 9 white oak, and that the burr oak population is increasing naturally. They also found more than 47 big trees, with the biggest a giant cottonwood more than 160 centimeters in diameter, the tallest a cottonwood more than 220 feet high, and the oldest a burr oak more than 160 years old. The Friends of Swede Hollow had ideas for more ecological research projects, so we are looking forward to a new set of projects next summer.

Sridevi Pudipeddi Augsburg College, St. Paul MN

3:15 - 3:45 FH Rec

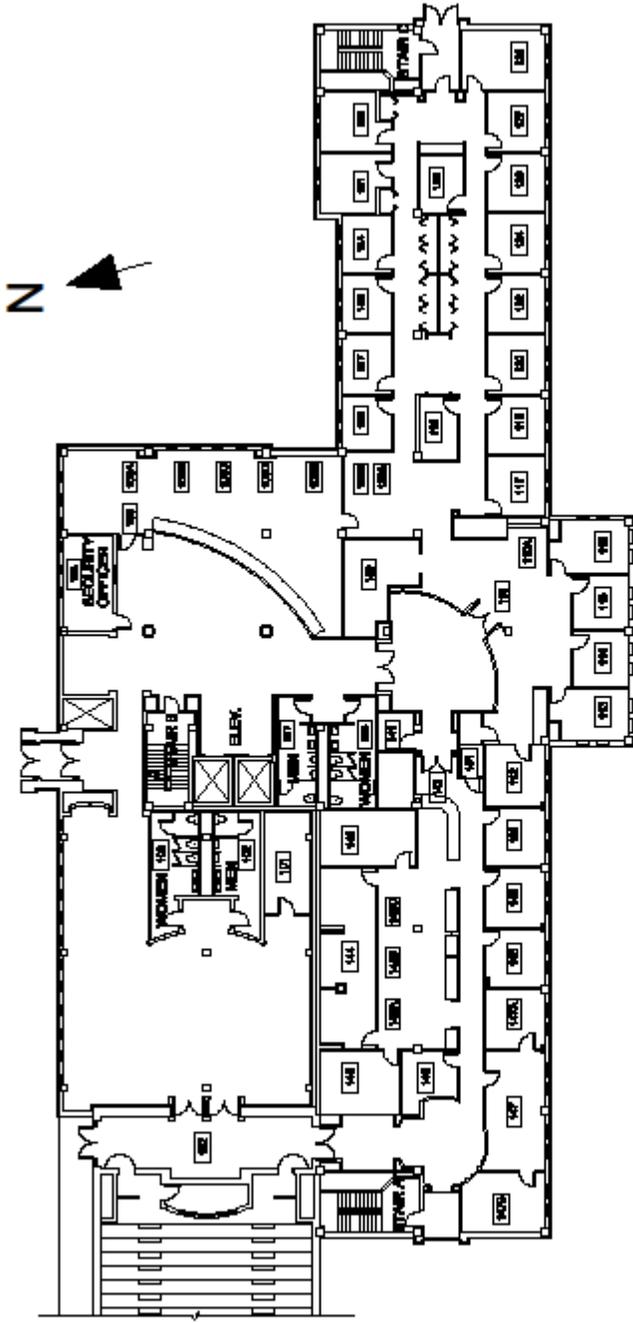
Real Data and Calculus to Model Flu In this poster, we want to show how to use real data and Calculus to model Flu. Students were given real data about the flu and they were asked to come up with the model for the flu using Calculus 2 techniques.

Participants

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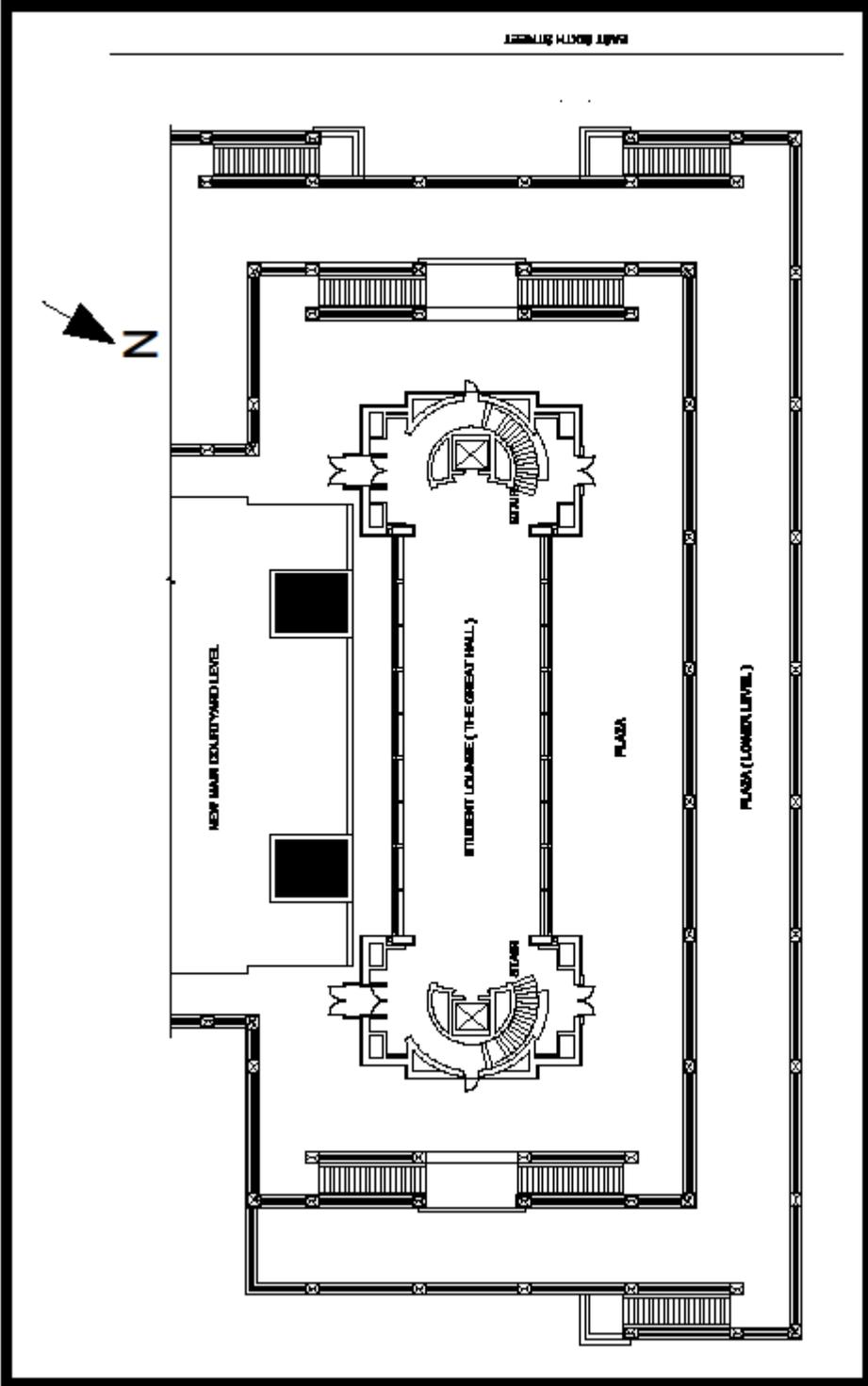
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**Founders Hall
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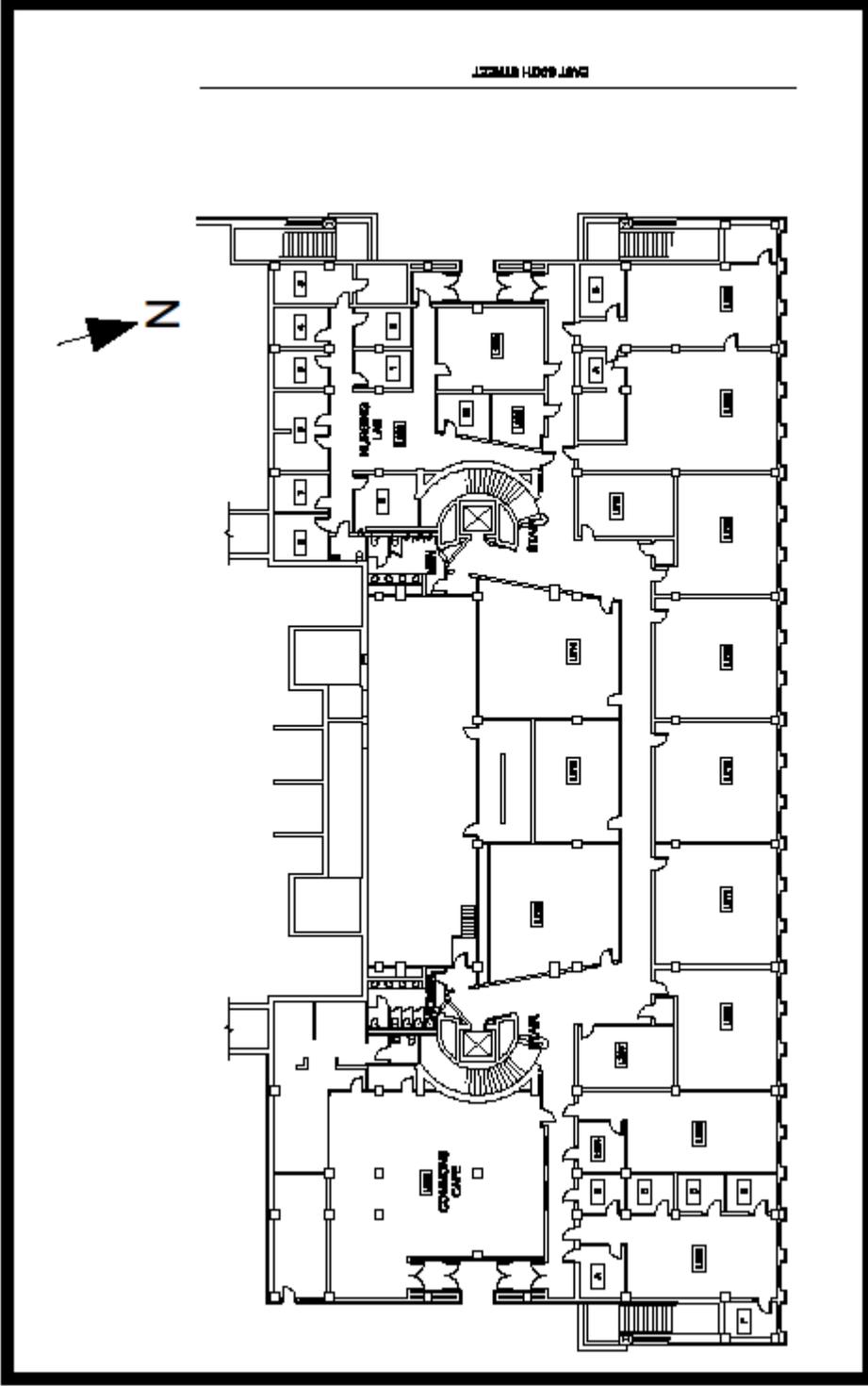
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