



Building Nevada's Brainpower

G² NV STEM EDUCATION COALITION

2011 PLAN

**Sponsored by
Gathering Genius, Inc.**

Mathematics and science are essential parts of the foundational knowledge that all students need to acquire, and learning in these disciplines enables students to acquire skills and understanding that are increasingly essential to their ability to succeed in high school and in careers. All students need a sophisticated working knowledge of mathematics and science; their schools must not fail them in this.

The Opportunity Equation: Transforming Mathematics and Science Education for Citizenship and the Global Economy. Carnegie Corporation of New York, Institute for Advanced Studies.

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	(from the STEMEd Caucus Steering Committee)	

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OVERVIEW AND PURPOSE OF the NV STEM EDUCATION COALITION

The G² NV STEM Education Coalition was founded by Gathering Genius, Inc., a 501 (c)(3) nonprofit whose mission is to promote leadership and collaboration among business, community, education, and government stakeholders to develop nationally recognized science, technology, engineering, and math (STEM) education for ALL Nevada students EC-16.

Our vision is that ALL Nevada students are provided the inspiration and opportunity to attain the necessary skills in STEM to be productive in their personal, work and civic lives. We look forward to the day when Nevada produces the skilled and innovative STEM workforce required to develop an internationally competitive and diversified economy that attracts key industries to our state.

G² NV STEM Education Coalition is a group of partners who are working together to advocate, educate the public; share knowledge; and build capacity, sustainability, quality, and access for ALL of Nevada's students. We are a member of the National Alliance of State Science and Math Coalitions and an affiliate member of the STEM Coalition of the National Science Teachers Association.

Nevada can be proud of the many teachers, schools, and districts that have exemplary STEM programs, but as a state our challenge is to

- expand quality STEM education to all students,
- communicate effectively statewide, and
- develop a cohesive, competitive, innovative STEM education plan.

During 2011 the G² NV STEM Coalition will

- build a strong organization of partners dedicated to creating, advocating for, *and sustaining* a comprehensive plan to increase Nevada's ranking in STEM education;
- develop a robust, wide-reaching, and effectively used website to improve communications and advocacy as well as community awareness and support;
- host a STEM education summit that will convene state leaders in education, business, government, and community to raise awareness and generate the foundation for a Nevada STEM Education Plan;

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- develop a comprehensive NV STEM Education Plan that would direct the way to Nevada's ranking in the top 15% of states in STEM education, innovation, and performance;
- submit the plan to Governor Sandoval and the Legislative Committees on Education for consideration by January 2012; and
- use this plan as direction and support to implement our long term goals of building capacity, innovation, competitiveness, increased diversity, and sustainability for Nevada's STEM education.

Long-term Goals for the NV STEM Education Coalition (Beyond 2011)

- Identify strategies to make the Coalition *sustainable* to ensure long-term success of our mission and goals.
- Identify and promote best practices in increasing the numbers of our disadvantaged and minority students who are able to enter fields and college paths that require strong STEM preparation
- Advocate for a diversified NV economy and the skilled workforce required to develop and sustain it
- Raise statewide awareness of the importance of scientifically competent citizens in Nevada, for their own lives as well as the State and Nation's economic and security needs
- Identify and share research-based best practices in STEM instruction Early Childhood-grade 12 including project based learning and interdisciplinary instruction.
- Advocate for higher standards and alternative paths for STEM teacher licensure, expanded opportunities and incentives for quality continuing teacher training, and an adequate supply of highly trained STEM teachers
- Develop strong partnerships with industry in Nevada to identify and promote STEM curriculum and practices that produce a highly trained workforce
- Identify, recognize, support, and expand outstanding STEM programs statewide

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- Advocate for cohesive curriculum, adequate materials and equipment that allow all NV students to attain the necessary STEM skills in order to be productive in their personal, work, and civic lives
- Promote formal and informal STEM experiences for youth that foster increased interest, curiosity, innovation, competitive skills, entrepreneurship, and teamwork
- Promote globally competitive and innovative technology systems, instruction, and access for every student and teacher
- Create a culture of STEM through fun and increased exposure and help children imagine and identify themselves in future STEM careers.

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GATHERING GENIUS, INC. BOARD OF DIRECTORS

(The Gathering Genius, Inc. Board of Directors is responsible for establishing goals and objectives for the G² Inc. STEM Coalition, fundraising, fiscal management of the entire organization and its projects, and sustainability)

Stephen G. Wells, Ph.D. President	(President, DRI)
Carol Lucey, Ph.D. Vice President	(President, Western Nevada College)
Jenny C. Frayer, MBA, CPA, Treasurer	(Interim Dir. of Sponsored Projects & Compliance, DRI)
Beth Wells, M.A., Secretary, Interim Ex. Dir.	(President, The Write Word Nevada, LLC)
Paul Buck, Ph.D.	(archaeologist, DRI; instructor, NSC)
Robert Casaceli	(mining consultant; former CEO of Franc-Or Corp.)
Ryan Costella	(Dir. of Strategic Initiatives, Click Bond, Inc.)
Kent Crippen, Ph.D.	(Assoc. Professor of Science Ed. & Technology, UNLV)
Mo Denis	(NV State Senator, Chair, Legisl. Comm. On Education)
David Miller, M.A.	(Coordinator, K-12 Science & Health, CCSD)
Sandy Miller	(former First Lady of Nevada)
Susan Moore, Ed.D.	(Senior Policy Advisor to Lt. Governor Brian K. Krolicki)
Jonathan Mueller	(exec. Dir., Sierra Nevada Journeys)
Stephen A. Philpott	(Dir. of FIRST Nevada Robotics; former owner/Pres. Bearing Belt Chain Co. Inc.)
Mary Pike, M.A.	(Dir. K-12 Science, Health, PE, and For. Language, CCSD)
Merrie Rampy, M.A.	(science teacher, Fernley H.S., Lyon County School District)
P.G. Schrader, Ph.D.	(Assoc. Professor, Dept. of Curr. & Instruction, UNLV)
Richard Simmonds, D.V.M., M. S.	(retired UNR institutional veterinarian)
Richard Vineyard, Ph.D.	(Dir. K-12 Science Ed, NV Dept. of Education)
Bill Wells, M.S.E.	(Technical Director. AtaPros, LLC)
Bobbie Heaton Wells, C.P.A	(Financial Director, AtaPros, LLC)
Mr. Don Bailey, board member emeritus	(retired Nevada State Printer)

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Gathering Genius, Inc. Advisory Committee

Mr. Robert Davidson, Founder of Davidson Academy

Mrs. Jan Davidson, Founder of Davidson Academy

Ms. Frankie Sue Del Papa, attorney, former Nevada Attorney General

Ms. Jill Derby, former member Nevada System of Higher Education Board of Regents

Carl Diekhans, Ph.D. President, Great Basin College

U.S. Senator John Ensign, Nevada

Edward Estipona, President, Estipona Group

Milton Glick, Ph.D. President, University of Nevada, Reno

Mr. Bruce James, former U.S. Printer

Shar Peterson, Senior External Relations for Phoenix Mine, Newmont Mining

Mary Pierczynski, Ph.D., Retired Superintendent of Carson City School District

Mr. Bill Raggio, former Nevada State Senator

U.S. Senator Harry Reid, Nevada

Keith Rheault, Ph.D. Superintendent, Nevada Department of Education

Michael Richards, Ph.D. President, College of Southern Nevada

Delores Sanford, Ph.D. VP of Finance and Administrative Services, Truckee Meadows Community College

Maria Sheehan, Ph.D., President, Truckee Meadows Community College

Neal Smatresk, Ph.D., President, UNLV

Joyce Woodhouse, former NV Assemblywoman

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G² NV STEM Education Coalition Steering Committee

(The G² NV STEM Education Coalition Steering Committee is a group of community leaders/experts who work with the G² Inc. board to establish goals and objectives, provide professional advice and leadership for the Coalition, educate the community, recruit partners, and promote innovation in STEM education.)

Crystal Abba, M.A., Assoc. Vice Chancellor for Academic and Student Affairs, Nevada System of Higher Education
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Tracy Gruber, Mathematics Consultant, NV Dept. of Education
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Donna Levy, Coordinator for Career and Technical Education, CCSD
Lou Loftin, M.A., Science Teacher Trainer, Northern Nevada Regional Professional Development Program
Cherri Luna, science specialist, Schorr Elementary School, CCSD
Larry Mason, Chief of Diversity, CSN, former member of CCSD school board
Camille McCue, President, Pea Brain, Inc.
David McElwain, Coordinator, Career and Technical Education, CCSD
Merrie Rampy, M.A., science teacher, Fernley High School, Lyon County School District
Lisa Riggs, Project Administrator, Signature Academies, WCSD
Ricci Rodriguez-Elkins, M.Ed., Principal, E-Techs Charter HS, former Pres. of the Center For Charter School Dev.
Carolyn Ross, Ph.D., Superintendent of Churchill County School District
Maria Sheehan, Ph.D., President of Truckee Meadows Community College
Brett Sibley, Southern Nevada Regional Professional Development Program
Richard Simmonds, Ph.D., adjunct professor and retired institutional veterinarian for Univ. of Nevada, Reno
Les Smith, Dream It Do It
Lee Solonche, Educational Media Services, Vegas PBS
Kim Vidoni, Ph.D., Ed. Technology Coordinator, NV Department of Education
Richard Vineyard, Ph.D., Director of Science, NV Department of Education
Bethany Wells, M.A., Interim Executive Director, Gathering Genius, Inc.
Terry Williams, Strategic Business Advisor, Adorian Corporation

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G² NEVADA STEM COALITION PARTNERS

The Coalition is building a statewide membership of individuals, organizations, and business partners who share a mission to improve Nevada's STEM education. We seek partners who are ready to work together to advocate; educate the public; share knowledge; and to build capacity, sustainability, quality, and access for ALL of Nevada's students.

Challenger Learning Center of Northern

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E-Techs Charter High School

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Joe Elcano, joe@KNPB.org

2/25/2011KNPB Channel 5 Public Broadcasting

Joe Elcano, joe@KNPB.org

Northern Nevada FIRST Lego League Dee Freewert,
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Vegas PBS

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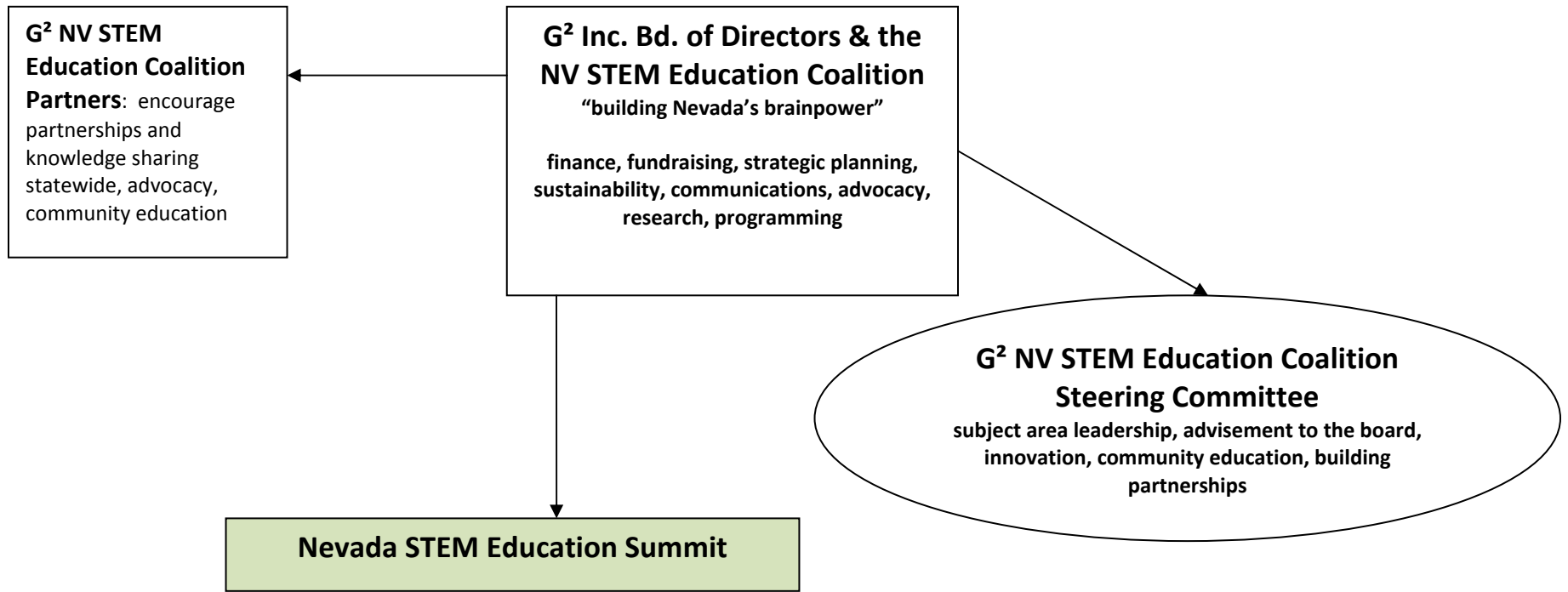
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Gathering Genius, Inc. and G² NV STEM Education Coalition



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2011 STEM EDUCATION COALITION SUMMIT PLAN

"Building Brainpower for a Prosperous Nevada"

Date: January 2012

Location: Las Vegas

Attendance: 250-300 invited guests, divided among leaders in education, business, community, and government

Fees: Goal is free attendance and food during conference and well as travel, housing, and substitutes for teacher and travel and housing for students

Goals:

- provide a forum for participants to review the latest STEM education research, learn about exemplary and innovative state and national practices and programming, identify new priorities, and shape state and local policy debates about how to promote EC-12 STEM competency and teacher training across the state;
- contribute to our efforts to make the public, state government, and more educators aware of the urgency of improving NV's STEM education--student performance, innovation, and interest in STEM careers;
- facilitate in-depth discussions of opportunities to improve STEM education and strengthen economic development in the State;
- provide teachers with inservice credits by asking them to report back to peers and supervisors;
- result in recommendations that will lead to a comprehensive Nevada STEM Education Plan that would direct the way to Nevada's ranking in the top 15% of states in STEM education, innovation, and performance;
- present the Plan by January 2012 to Governor Sandoval and the Legislative Committee on Education for possible implementation; and
- provide G² Inc. and the NV STEM Education Coalition with direction and strong support for achieving our long-term goals of building capacity and contributing to sustainability for Nevada's STEM education.

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Roundtable Topics

- EC – 12 Education: Core Preparation, Exploration, and College Readiness;
- Technology: Infrastructure and Innovation;
- Teacher Preparation, Licensing and Continuing Education;
- Workforce Readiness: Career & Technical Education and Entrepreneurship;
- Ensuring Diversity in Access to STEM Education;
- Informal Education: Topics Beyond the Classroom; and
- STEM Education Path and Higher Education

Activities

- Three high-level speakers to discuss the state of STEM education in the nation and Nevada as well as an inspirational talk about the vision Nevada can achieve. Panel discussion at the conclusion responding to roundtable reports
- Seven roundtable topics, repeated twice, once in the morning and once in the afternoon. This allows for participants to choose two topics to attend.
- Each roundtable has a committee of 6-7 experts in that field with additional advisors as necessary. Experts are providing direction for handbook contents and discussion questions and will each a discussion table of approximately 6 attendees.
- Participants receive a handbook in advance that includes research summaries, descriptions of state and national exemplary and innovative programs, relevant statistics, ideas for reform, and discussion questions.
- The two repeated roundtable sessions meet late in the afternoon to share results.
- Notetakers in each session use the evening to collate the notes and create PowerPoint slides of key results to present to the entire assembly.
- Presenters of roundtable results could be asked to present the ideas in the form of describing how their recommendations might look like in an ideal school
- Poster sessions of students/teachers/administrators on innovative STEM curriculum
- Provide teacher inservice credit—ask teachers who attend to do a poster or other visual and do a presentation to peers and supervisors in their schools when they return

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Marketing Plan and Funding

- Marketing and media coverage will be designed to make the public aware of key issues and work toward solutions
- G² Inc. is seeking summit sponsors by approaching all former donors who supported the 2009 Intel ISEF as well as new potential donors. NSF informal conference proposal has been submitted.

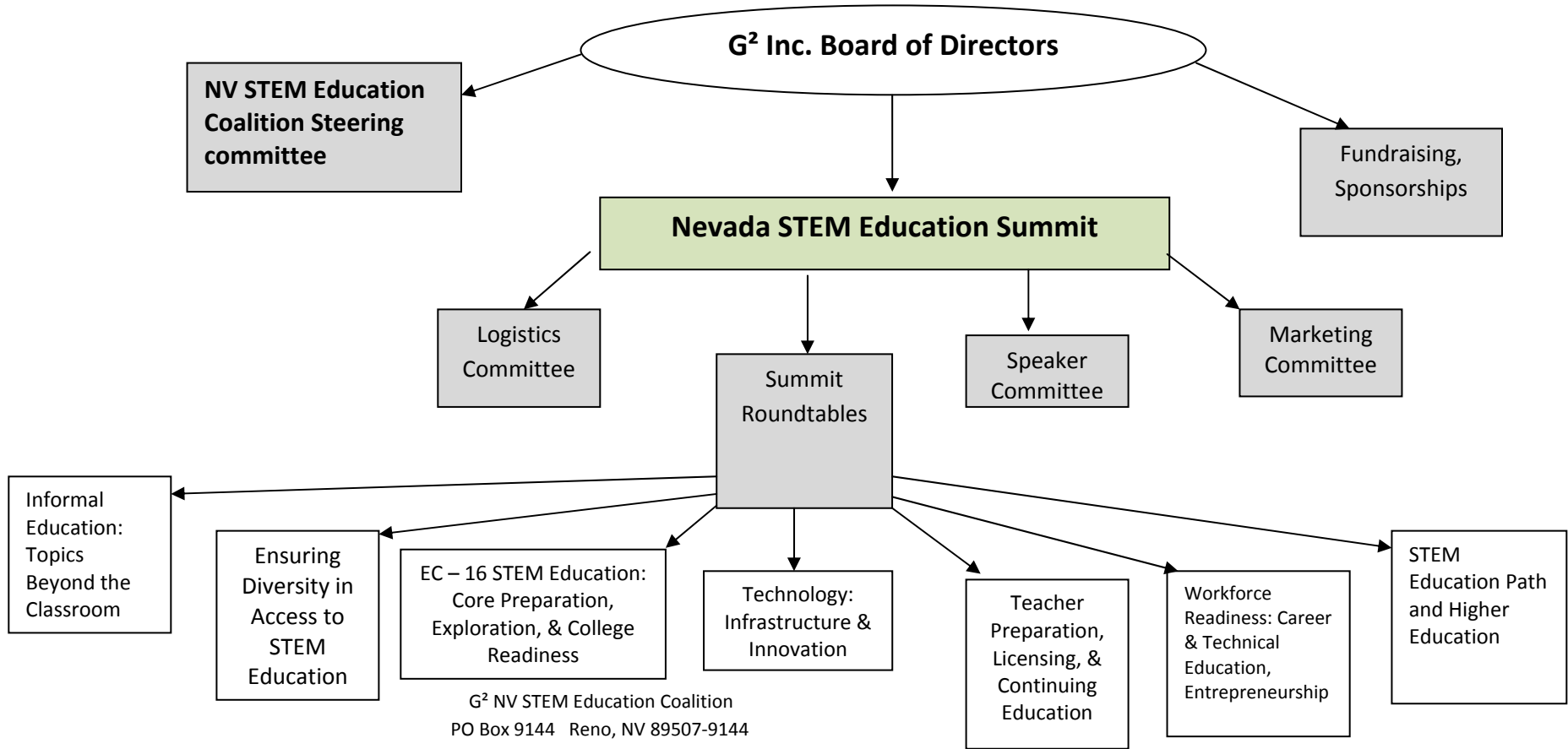
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Organization Chart for the Implementation of the 2011 STEM Education Summit



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HISTORY AND BACKGROUND OF GATHERING GENIUS, INC.

Gathering Genius, Inc., is a 501 (c)(3) nonprofit whose mission is to promote leadership and collaboration among business, community, education, and government stakeholders to develop nationally recognized STEM education for ALL Nevada students EC-16. Our board is composed of statewide leaders in education, business, government and community. We are leveraging our organization's resources and experience to support a statewide STEM Education Coalition and STEM education conference. The Governor's Blue Ribbon Task Force has submitted a report to Governor Gibbons and Governor-Elect Sandoval that recommends the creation of a Nevada STEM Education Coalition.

G² Inc. raised \$1.1 million to bring the Intel International Science and Engineering Fair to Reno in 2009. We hosted and managed the fair in partnership with Intel, the Society for Science and the Public, and the City of Reno. The fair was said to have been one of the best managed international science fairs in many years. Due to the generosity of Nevada's sponsors and donors coupled with strong fiscal controls, the nonprofit ended the fair with \$80,000 in surplus revenue that we are using to support the G² NV STEM Education Coalition. For the 2008-09 and 2009-10 school years, G² Inc. also funded teacher training and support in order to increase the numbers of teachers who recruit and mentor student competitors for regional science fairs in the state. The program resulted in improving regional science fair competitors and increasing the number of students who entered the Intel International Science fairs.

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Why Does Nevada Need to Focus on STEM Education?

National statistics demonstrate that the U.S. is in a state of crisis regarding the low numbers of students who are pursuing and completing post high school training/college degrees in the STEM fields compared to our global competitors. U.S. students' STEM test scores in international measurements show that we are mediocre at best. The U.S. is in danger of losing its competitive edge in producing the educated workforce that we need to remain globally competitive.

Nevada has a number of outstanding and innovative STEM teachers, programs, and schools, but they do not begin to address the need for providing quality curriculum, resources, trained teachers, and fair access to the basic STEM skills that ALL Nevada students need to be productive in their personal, work, and civic lives. Not all elementary students in Nevada (and the nation) have access to discovery-based mathematics, science, and technology that generate curiosity, interest, and innovation as well as develop problem solving and teamwork-- skills that are in high demand by businesses looking to hire employees. Numerous observations suggest that most children who are "turned off" to science and math have made these conclusions in elementary school, where most teachers do not have degrees in the STEM fields.

Nevada was not awarded points for the STEM Priority section in the 2010 Race to the Top application. While the reviewers recognized the merit of the proposed STEM programs, they also noted the lack of a comprehensive, statewide STEM agenda as well as a plan to address the needs of underrepresented populations, including women and girls.

According to the Bureau of Labor and Statistics, "All jobs of the future will require a basic understanding of math and science. The most recent ten year employment projections by the U.S. Labor Department show that of the 20 fastest growing occupations projected for 2014, 15 of them require significant mathematics or science preparation to successfully compete for a job." It takes years of quality instruction to develop students motivated and ready for post high school STEM training, college, or careers. According to the National Academy of Sciences, eight studies indicate that "public investments in science and technology have produced annualized societal returns that range from 20% to 67%." If Nevada chooses to make a long term commitment to become more nationally and globally competitive, investments in a competitive workforce as well as science and technology research are central to success in attracting business and diversifying our economy.

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Appendix A- Documentation

Nevada Race to the Top Competition

“NV Race to the Top--Competitive Preference Priority 2: Emphasis on STEM only received two scores of the full 15 points, whereas the other three reviewers cited the lack of quality and coordinated plan as a reason for not receiving points. While several STEM-related activities are individually listed, they do not collectively reflect a broad comprehensive STEM agenda. In addition, reviewers cited the failure to define or elaborate on the underrepresented populations in STEM education and/or careers, such as women and girls, as a reason for not awarding points. Given that a majority of the five reviewers were not convinced about our emphasis on STEM, zero points were awarded.”¹

Lack of U.S. Students Entering STEM Fields

- “Rather convincing empirical evidence suggests that most children who are ‘turned off’ by mathematics and science have already arrived at that conclusion by the time they are in 4th grade. The die is usually cast by a teacher who finds teaching science and mathematics an unwelcome and intimidating burden or by a parent with a disinterest or disdain for these fields.”²
- “Ninety-three percent of US public school students in fifth through eighth grade are taught the physical sciences by a teacher without a degree or certificate in the physical sciences.”³
- “American students’ disinterest in math and science continues at the graduate level too, where less than 10% of degrees are conferred in engineering, math, and computer science. This places our country 20th internationally in terms of the share of graduate degrees in these critical areas.”⁴
- “...more than 40% of US doctoral students in engineering, mathematics and computer science are foreign nationals. In several fields, it is more than half.”⁵
- 50% of all engineering degrees awarded by U.S. engineering colleges *go to foreign nationals*.⁶
- 90% of the world’s scientists and engineers live in Asia⁷



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International STEM Test Scores and Comparisons

- The Program for International Student Assessment (PISA), which measures the science, mathematics, and reading literacy of students from more than 70 economies reported that the average science scores for American 15-year-olds is up slightly, with U.S. students ranking 17th in science and now in the “average” performers categories among OECD nations.⁸ The OECD countries with higher average scores than the United States were Finland, Japan, Korea, New Zealand, Canada, Estonia, Australia, the Netherlands, Germany, Switzerland, the United Kingdom, and Slovenia.
- In the PISA measurements for mathematics, U.S. students ranked 25th and outperformed their peers in math in only five OECD countries.⁹ The OECD countries with average scores higher than the U.S. average were Korea, Finland, Switzerland, Japan, Canada, the Netherlands, New Zealand, Belgium, Australia, Germany, Estonia, Iceland, Denmark, Slovenia, Norway, France, and the Slovak Republic.
- “The hard truth,” Secretary [of Education] Duncan said at Tuesday’s PISA announcement, “is that other high-performing nations have passed us by during the last two decades...In a highly competitive knowledge economy, maintaining the educational status quo means America’s students are effectively losing ground.”¹⁰
- “The World Economic forum ranks the United States 48th in quality of mathematics and science education.”¹¹

Jobs of the Future and STEM Requirements

- “The most recent ten year employment projections by the U.S. Labor Department show that *of the 20 fastest growing occupations projected for 2014, 15 of them require significant mathematics or science preparation to successfully compete for a job.*”¹²
- The Nevada Department of Employment, Training, and Rehabilitation notes that Nevada will see increases of 20-43% in some computer and medical occupations between 2008 and 2018.¹³

Nevada’s Lack of Sustained Commitment to Education

- Nevada is now 50th in the nation in access to technology in the classroom.¹⁵

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- Nevada's college completion rate has been computed as low as 48% (analyses vary).¹⁶
- Only 22% of Nevada adults hold college degrees, compared with nearly 28% nationwide.¹⁷
- Nevada has the highest high-school dropout rate in the nation. According to the U.S. Department of Education, the average freshman graduation rate at public secondary schools in Nevada was 52% for the 2006-2007 school year compared with the national average of 74%.¹⁸
- "In 2007, per pupil spending in Nevada was \$7,845, 26% lower than the \$10,557 U.S. average."¹⁹
- "The percent of taxable resources spent on education in Nevada is 2.9%, whereas the U.S. average is 3.8%, making Nevada the second lowest in the nation."²⁰

The Nation's Economic Future

- "Eight studies conducted in recent decades indicate that public investments in science and technology have produced annualized societal returns that range from 20% to 67%. Some economists estimate that about half the nation's growth in gross domestic product per capita during the last half-century can be attributed to scientific and engineering achievements."²¹
- "The National Academies *Gathering Storm* committee concluded that a primary driver of the future economy and concomitant creation of jobs will be *innovation*, largely derived from advances in science and engineering. While only four percent of the nation's workforce is composed of scientists and engineers, this group disproportionately creates jobs for the other 96 percent."²²
- Of Wal-Mart's 6000 suppliers, 5,000 are in China.²³
- "Almost one-third of U.S. manufacturing companies responding to a recent survey say they are suffering from some level of skills shortages."²⁴
- "United States consumers spend significantly more on potato chips than the government devotes to energy R&D."²⁵

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ENDNOTES

- ¹(<http://www.nevadaracetothetop.org/pdfs/report-11-23-10.pdf>. p.27. accessed Dec. 12, 2010.
- ²Rising Above the Gathering Storm, Revisited: Rapidly Approaching Category 5. National Academy of Science, National Academy of Engineering, and Institute of Medicine. The National Academies Press, Washington, D.C 2005. www.nap.edu
- ³National Center for Education Statistics, Qualifications of the Public School Teacher Workforce: Prevalence of Out of Field teaching 1987-1988 and 1999-2000, Washington, D.C., U.S. Department of Education, 2003.
- ⁴A Commitment to America's Future: Responding to a Crisis in Mathematics and Science Education, January 2005; National Science Foundation, *Science & Engineering Indicators – 2004*
- ⁵Ibid.
- ⁶American Association for the Advancement of Science, Report XXX: Research and Development FY 06, Chapter Two, "Historical Trends in Federal R&D, Appendix Table 2-22.
- ⁷Prediction by Richard E. Smalley, Gene and Norman Hackerman Professor of Chemistry and Professor of Physics & Astronomy, Rice University, in a PowerPoint presentation, "Nanotechnology, the S&T Workforce, Energy, an Prosperity," to the President's Council of Advisors on Science and Technology (PCAST), March 3, 2003.
- ⁸<http://www.ed.gov/blog/2010/12/international-education-rankings-suggest-reform-can-lift-u-s/>
- ⁹Ibid.
- ¹⁰Ibid.
- ¹¹World Economic Forum, The Global competitiveness Report 2009-2010, Available at: <http://www.weforum.org/pdf/GCR09/Report/Countries/United%20States.pdf>.
- ¹²Bureau of Labor and Statistics, Fastest growing occupations, 2004-14, <http://www.bls.gov/emp/emptab21.htm>
- ¹³www.nevadaworkforce.com/cgi/dataanalysis
- ¹⁴Rising Above the Gathering Storm, Revisited: Rapidly Approaching Category 5.
- ¹⁵State of Nevada National Assessment for Educational Progress" <http://www.nevadareportcard.com>
- ¹⁶http://www.wested.org/online_pubs/NevadaReport.pdf
- ¹⁷2007 Kids Count Data Book
- ¹⁸Education Week, Chance for Success (January 14, 2010) at www.edweek.org/go/qc10
- ¹⁹Ibid
- ²⁰EPE Research Center, Quality Counts 2010: Fresh Course, Swift Current (2010)
- ²¹Is America Falling Off the Flat Earth? <http://www.nap.edu/catalog/12021.html>
- ²²Rising Above the Gathering Storm, Revisited: Rapidly Approaching Category 5, p-. 2-3
- ²³P. Goodman and P. Pan, Chinese works Pay for Wal-Mart;s Low Prices: Retailer Squeezes its Asian Suppliers to Cut Costs, *The Washington Post*, Feb. 8, 2004.
- ²⁴Deloitte, Oracle, and the Manufacturing Institute, People and Profitability: A time for change, 2009
- ²⁵For 2009 U.S. potato chip sales of \$7.1 billion, see <https://www.aibonline.org/resources/statistics/2009snack.htm> For US federal government spending on energy R&D of \$5.1 billion, see American Energy Innovation Council, A Business Plan for America's Energy future, 2010.

Appendix B-Why is STEM Education Important?

From the STEMEd Caucus Steering Committee:

<http://www.stemedcaucus.org/content/documents/TalkingPoints.doc>

- We live in an increasingly “Flat World” where data is transferred across oceans almost instantaneously and business takes place around the clock. A more integrated global economy offers both new challenges and opportunities to the United States and its workforce. To succeed, it is essential that the U.S. maintain its position as the world’s leading innovator.
- Looking back over the 20th century, American ingenuity has been truly incredible. From Ford’s Model T in 1908 and on to the washing machine (1911), refrigerator (1924), microwave oven (1953), modem (1958), hand-held calculator (1967) and the personal computer (1981), American innovations have transformed our nation, again and again, creating whole new industries and occupations. Going forward, new innovations will continue to be critical, both in maintaining a solid industrial base and increasing our standard of living.
- In short: Innovation leads to new products and processes that sustain our industrial base; innovation depends on a solid knowledge base in math, science and engineering; without this knowledge base, innovation as well as our industrial base will erode.
- Along those lines, all jobs of the future will require a basic understanding of math and science. The most recent ten year employment projections by the U.S. Labor Department show that of the 20 fastest growing occupations projected for 2014, 15 of them require significant mathematics or science preparation to successfully compete for a job¹
- Even the requirements for occupations that historically did not require a high school education have dramatically shifted. In the last 30 years, the share of factory workers without a high school degree fell from more than half to just one in five (21%). At the same time, those with a post-secondary education had reached 31 percent. If current trends continue, over 40 percent of factory jobs will require post-secondary education by 2012².

Isn't Our Current Educational System Working Well?

- Most Americans feel that they received a good education and that their children will as well. Unfortunately, not many are aware our country has been falling behind, particularly in the areas of math and science, when compared with our international competitors. Independent of other countries, our students are on average getting worse in these subjects and not pursuing them in college.
- According to the National Center for Education Statistics, about one-third of the fourth-graders and one-fifth of eighth-graders cannot perform basic mathematical computations, and U.S. high school seniors recently tested below the international average for 21 countries in mathematics and science.³ As a result, fewer American students than ever are graduating from college with math and science degrees.
- When compared with our international competitors, we are not performing well. In 1995, U.S. fourth graders ranked 12th against other nations when it came to mathematics competency⁴. By the 8th grade their ranking dropped to 19th, below not only Asian students in countries such as Korea, Japan and Taiwan, but also below students in many Eastern European nations such as Bulgaria, the Czech Republic and Slovenia.
- A similar deterioration has occurred in science. In 1995, U.S. fourth graders ranked 6th in science competency. By the 8th grade their ranking dropped to 18th, below many of the same countries cited above. More recent rankings of U.S. students relative to their counterparts around the globe have been no more encouraging with respect to America's future ability to compete.
- Countries outperforming the U.S. in science and math, on average, spend 10 percent less of their respective GDPs on primary and secondary education than we do⁵. Obviously, there are other important educational elements that go beyond funding, such as the fact that nearly 70 percent of U.S. middle school students are taught math by teachers with neither a major nor certification in this critical subject. Internationally, the average is 29 percent⁶.
- The story is not much better at the higher educational levels. The interest of young Americans in science and technology has eroded over time. In 1960, one out of every six (17 percent) U.S. bachelor or graduate degrees was awarded in engineering, mathematics or the physical sciences but by 2001, that number had dropped to less than one in 10 (just 8 percent) of all degrees



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awarded in the U.S.⁷. This constitutes more than a 50 percent decline from 1960. In terms of actual numbers of graduates in these critical areas, the U.S. produced just 148,000 in 2001 — the smallest number in two decades⁸. At this rate, our educational system will fail to meet our economy's workforce demands by the end of this decade.

- American students' disinterest in math and science continues at the graduate-level, too, where less than 10 percent of degrees are conferred in engineering, mathematics and computer science. This places our country 20th internationally in terms of the share of graduate degrees in these critical areas⁹. Furthermore, more than 40% of U.S. doctoral students in engineering, mathematics and computer science are foreign nationals. In several fields it is more than half¹⁰.
- 50% of our current science and engineering workforce is approaching retirement¹¹
- Also, the retiring workforce of baby boomers in science, mathematics and engineering over the next decade must be encouraged and offered pathways to enter teaching upon retirement.
- Studies show that many teachers leave the profession after 5 years or less, so we need to provide beginning math and science teachers with induction programs for retention and development – and make sure that is sustained support.
- To attract and retain precollege science and mathematics teachers, we must provide quality, sustained professional development experiences for all K–12 science and mathematics teachers that will increase and deepen content knowledge, promote a variety of pedagogical approaches and develop questioning strategies, which will advance higher order thinking of all their students.

What Can We Do to Improve STEM Education?

- There is a strong and growing consensus in the business, scientific, and education community that we must revitalize our commitment to strengthen the pillars of American innovation and competitiveness – basic research in the physical sciences and math and science education
- Investment in basic research in the physical sciences (chemistry, physics, materials, etc) is an essential element in assuring our future economic prosperity, homeland security, and leadership in a rapidly evolving world

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- Projections indicate over the next decade for the need of over 2 million teachers, of which 240,000 will be middle and high school mathematics and science specialists². Coordinated efforts must be made to recruit pre-service teachers to enter mathematics and science studies, and gain certification.
- America's global competitiveness will increasingly depend on our ability to better educate our young people in math and science and to attract more of our best and brightest students into technological careers
- Developing and retaining a high quality mathematics and science teaching workforce is key, and Congress has focused funding on loan forgiveness for teachers and is considering several proposals that would provide scholarships for students to become teachers in science and math fields.
- Encourage higher education leaders to strengthen K–8 teacher education programs to provide a deeper understanding of the content knowledge necessary to teach mathematics and science.
- Invest in research on teaching and learning that will better inform development of science and mathematics curricula and pedagogical approaches.
- Review teacher education programs focusing on the extent to which prospective teachers are grounded in academic content in the subjects they will teach.

Endnotes

¹Bureau of Labor and Statistics, Fastest growing occupations, 2004-14, <http://www.bls.gov/emp/emptab21.htm>

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³National Center for Education Statistics

⁴International Association for the Evaluation of Educational Achievement

⁵OECD, 2000.

⁶U.S. Department of Education, Qualifications of the Public School Teacher Workforce: Prevalence of Out-of-field Teaching 1987-88 to 1999-00. Statistical Analysis Report, Table 1.

⁷National Science Foundation. Science and Engineering Indicators, 2004

⁸U.S. Department of Education, National Center for Education Statistics, Higher Education

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¹⁰A Commitment to America's Future: Responding to a Crisis in Mathematics and Science Education, January 2005; National Science Foundation, *Science & Engineering Indicators – 2004*

¹¹U.S. Chamber of Commerce, Tapping America's Potential: The Education for Innovation Initiative, July 2005

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