PROJECT DESCRIPTION: The Council of Chief State School Officers (CCSSO)[i], and its members who head the State Education Agencies, propose collaborating with NASA and other partners to establish a "Virtual Learning Magnet (VLM) for Space Science and Mathematics" to meet emerging needs of the education system and the challenges of a new era. The VLM is not geographically bound. It is based on new models of continuously emerging networked technologies. The VLM for Space Science and Mathematics is designed to allow any student anywhere to reap the benefits of the most rigorous, exciting and engaging magnet program and stay enrolled in his/her "sending school".

The VLM for Space Science and Mathematics is an online learning program, not a credit-granting school. Unlike traditional virtual schools, it is specifically designed for students who have a demonstrated interest in space science or mathematics. The VLM will supplement and add value to the foundation of services provided by state education agencies, local school districts, and regional online learning programs. Students will continue traditional course work in their sending schools and also enroll in learning opportunities through the VLM. In each affiliating state, CCSSO will establish a relationship with the state virtual learning program for enrollment, student recruitment and selection, and student supports. In return, the state virtual school will have access to content created for the VLM.

CCSSO is uniquely positioned to galvanize and convene chief state school officers and state education agency staff around key issues because state chiefs are the nexus point for driving systemic educational change in the United States. Chiefs from most states have already signed letters of commitment to the VLM (see attached). CCSSO is seeking resources through this grant to support the states by successfully implementing the Virtual Learning Magnet for Space Science and Mathematics and taking new ideas to scale. NASA is, therefore, in a unique position to have profound influence on CCSSO's success towards addressing unmet educational needs and also to make gains across the states towards NASA's three major education goals:

- Strengthen NASA and the nation's future workforce
- Attract and retain students in STEM disciplines
- Engage Americans in NASA's mission.

PROJECT PURPOSE: Through the Virtual Learning Magnet, CCSSO is pursuing the following broad goals:

- Ensure that any student with a passion for space science has access and opportunity to develop the knowledge and skills that can lead to a career in that field
- Motivate under-engaged or at-risk students with an interest in space science to achieve in STEM disciplines in high school through interest-driven experiences
- Demonstrate that traditional school systems and virtual schools can collaborate across states to develop a learning delivery system for the education needs of the new century

Documented evidence of customer need

1. STEM learning and instruction need improvement
   - U.S. students perform below par on science and math assessments[ii]
   - There are large gaps in achievement between various ethnic/racial subgroups. [iii]

- The National Governor's Association recognizes the need for significantly improved STEM education as a key to American prosperity[iv]

2. Jobs in engineering and science are predicted to grow at more than 3x that of other professions and at a rate of 18% between 2006 and 2016[v]
    - Fewer high school students are interested in obtaining a degree in those fields[vi]
    - The US has gone from 3rd to 17th in the percentage of students pursuing natural science and engineering degrees since 1975[vii]
3. NASA Needs to Recruit, Prepare and Retain a Young, Diverse Workforce[viii]
    - NASA documented the need in a 2006 workforce strategy study
    - More than 30% of current NASA employees are eligible for retirement, and less than 20% of the space agency's workforce is under 40 years old
4. Need for Online Learning and Online Access to Qualified Teachers is Growing
    - Only 57% o*f* our public secondary schools provide students access to online learning[ix]
    - 52% of middle school and 15% of high school math teachers did not have a major or minor in math and 40% of middle school and 11% of high school teachers did not have a major or minor in science[x]
    - 47% of students said a major reason for dropping out was that "classes were not interesting" and they were "bored"[xi]
    - 6,000 talented young people will drop out of school on average each day[xii]
5. The US lacks a comprehensive plan to utilize current STEM learning resources
    - NASA resources are often dependent on geography or a specialized, localized program. Many students cannot participate because of a school boundary area, or the school, district or region chooses not to be involved
    - Professional support from knowledgeable teachers and professionals is not evenly available to students. Minority students are more likely to have poor instruction with poor resources delivered by inadequately prepared teachers.[xiii]
    - Students, teachers and professionals lack a comprehensive vehicle to learn, research, investigate or undertake complex collaboration beyond classroom walls
6. States are anxious for a collaborative, well-researched, innovative system based on best practice that will meet their needs
    - Schools and states acting alone lack resources to individually aggregate resources for the highest powered learning opportunity to every student in their state or jurisdiction
    - State Chief School Officers have discussed the need for collaborative efforts at each gathering for the past two years as reflected in their minutes

Proposed work meets or addresses the customer need

1. The VLM offers a way to improve STEM-related learning and instruction for any learner, regardless of geography.
    - By offering specialized, targeted curriculum to learners with identified or professed interest in space science, the VLM adds value to existing and emerging resources by matching the learner to the lens through which s/he learns.
    - Learners and mentors gain unprecedented ability to meet student requirements.

- Flexibility, relevance and a sense of control are known to be key in increasing student interest and, therefore, achievement. The VLM's unique curricular design maximizes these elements yet holds students to internationally benchmarked standards.
- The VLM maximizes collaboration. Learners from any state or jurisdiction will be able to participate in the VLM, relieving individual states from a sense of having to compete for pieces of a very limited pie or creating the whole on their own.
- The design increases interaction among learners, among learners and teachers, between learners and course content, and between learners and real-world content applications.
- The design integrates the best of the traditional classroom experience with the best of online learning in powerful ways that no other format makes possible.

2. Performance-based credits make it possible for learners to match time needed with time taken so that they can meet standards and complete courses in less time than a traditional semester or a year.
   - The VLM is available to learners 365 days a year, 24 hours a day. Learners can complete more specialized courses than in a traditional virtual or bricks and mortar school.
   - Learners' interest in and commitment to STEM related fields will increase because opportunities will increase rather than decrease as they progress.
   - Post-secondary learning opportunities, as well as virtual and hands-on lab experiences are built into the fabric of the VLM.
   - Learners will graduate having established relationships with a postsecondary institution(s), key industries, NASA, and other partners to continue specialized education and preparation for career.
3. The VLM provides a comprehensive plan to use existing and emerging STEM resources.
   - Ultimately, resources developed for and used in the VLM will be available to any learner and to all schools, through the VLM or through other distribution channels, including state virtuals.
     - The VLM design makes it possible to reach **any under-served students in any under-resourced school** with specialized, targeted learning.
     - The VLM provides minority and majority students access to a qualified teacher and professional support.
   - The VLM builds in collaborative study and research that reach beyond geography.
4. The VLM provides a learning environment inside the school reflective of the real world outside the school.
   - 21st century students function in a socially-complex networked environment outside the school and the VLM uses social networking as a fundamental learning tool.
5. The VLM provides struggling students with a supportive option.
   - States and districts are looking for options that will increase graduation rates among traditionally underprepared students. Research tells us that these students will respond to highly personalized learning environments, choice, and a high degree of relevance to an area of academic and career interest.[xiv]
6. CCSSO is uniquely positioned to help jurisdictions develop a rigorous, well-researched, collaborative project of this nature.

Evidence that the proposed work will be grounded in education research or best practices

1. Online learning provides individualized, high-quality learning in innovative ways.

- It has the advantage of personalization, individualized attention and just-in-time supports. An Ed Sector Report on virtual learning notes: "A broad range of new and emerging technologies—from immersive simulations to cognitive tutors—are being developed to engage learners and improve teaching." [xv]
- On average, students perform equally well or better academically in online learning.[xvi]
- Teachers who teach online reported positive improvements in face-to-face, too.[xvii]

2. Virtual schools are expanding access.
   - K-12 online learning is growing at an estimated pace of 30% annually.[xviii]
   - 42 states have significant supplemental online learning programs, significant full-time programs, or both.[xix]
   - In 2000, there were 40,000 – 50,000 enrollments in K12 online education. The Peak Group estimates 1,000,000 enrollments in 2007.[xx]
   - Harvard researchers predict that 50% of high school courses will be online by 2019.[xxi]
3. K-16 college pipelines are strategic in attracting and supporting a young, diverse workforce.
   - The National Action Council for Minorities in Engineering notes participation among underrepresented minorities in STEM fields has flat-lined, or declined. Only 4 percent of underrepresented minorities who graduate high school are "engineering eligible"[xxii]
   - 50% of undergraduates in this country enter postsecondary through community colleges. Minorities, first generation college students, and students in poverty are over-represented in the community college population. [xxiii]
   - The Bill and Melinda Gates Foundation launched "Postsecondary Education+: An Initiative to Expand Social Mobility in America". Its focus is two-year colleges, and noted, " Two-year colleges are the key in the pipeline to affect young people facing difficult challenges during the transition-to-adulthood period. . .Their racial and ethnic mix mirrors nationwide demographics; the four-year system tends to be disproportionately white."[xxiv]
   - For under-represented students, the VLM will focus on developing early relationships with community colleges and first-tier research universities that: support and incentivize emerging student interest in STEM; surround the student with strong advising for college planning and financial aid; provide outreach to families; and, facilitate successful transition to post-secondary STEM studies.
4. Open-source channels are effective distribution mechanisms.
   - VLM content will be available worldwide via public websites such as the National Repository of Online Content and state virtual learning networks. At the end of the 2007-08 school year, there were more than 1.3 million page views per month at NROC HippoCampus alone. More than 4,000 instructors created custom versions of HippoCampus and make regular assignments to the content. Nearly 100 academic institutions have joined NROC, including 21 state departments of educations, as well as institutions in Asia, Latin America, and Africa.[xxv]
5. Evaluating online learning is challenging, but effective approaches are emerging.
   - The US Department of Education sponsored an analysis of 7 evaluations of online learning programs.[xxvi] The report provides 7 overarching recommendations. The VLM will use the USED recommendations to design an overall evaluation. Those recommendations will complement the more specific evaluation on student performance as guided by the CCSSO SCASS.[xxvii]

Use of NASA content/resources, meeting NASA's education priorities: Building on an existing partnership with NASA, from January through June 2009, a group of high school students will be supported in online learning of physics and a mission-centric independent study using NASA content as the first step towards implementation of the Virtual Learning Magnet for Space Science and Mathematics. CCSSO is seeking this award to go beyond the Proof of Concept to fully develop the VLM as a multi-year opportunity for students to earn STEM credits towards a diploma, dual credit to begin postsecondary STEM studies, and establish relationships with NASA and industry partners leading to college and work for every student involved. This effort is in direct support of NASA Education Outcome 2 (Elementary and Secondary Education) (p.27 of Announcement) and Tactical Objective, Develop Projects, Activities, Modules and Approaches that Benefit High School Learners (p. 24). CCSSO intends to demonstrate that high levels of achievement in STEM learning and teaching can be fostered among a diverse population through innovative, replicable, and nationally scalable instructional approaches unrestricted by demographics, time or place. The VLM will mature to become an innovative P16 pipeline, undergirded with student supports leading to STEM careers, with emphasis on traditionally underrepresented students, and focusing on the development of NASA's future workforce in support of the Education Goal, Strengthen NASA and the Nation's Future Workforce and Strategic Objective (p.27), Build a Continuity of Experiences that Result in a Well-Trained Qualified Workforce (p.24)

The VLM will combine technological and social forces with NASA mission content and be available to any learner who has network access and a passion for space science, supporting the NASA Strategic Objective, "Use Educational Technologies to Reach a Wide and Diverse Audience" (p.24). Existing NASA content will be re-purposed, adapted or modified to create courses for credit and independent studies which are tagged or indexed against standards to identify how that content may be used within and across disciplines to support inter-disciplinary thinking, in support of Tactical Objective, Repurpose, Adapt Modify existing NASA education materials (p.24). Working under NASA's guidance to ensure appropriateness and scientific soundness in context, content will also be harvested from primary source materials, including data sets, images, video, simulations, training materials and other artifacts of mission activities in support of Strategic Objective, Provide Access to Authentic NASA Data, Resources and Facilities (p.24).
Students, teachers, and other formal and informal learning partners will create additional content for the content repository as a by-product of work in the VLM. The VLM will manage content as learning objects that can be infinitely recombined. The VLM design promotes and accommodates states' ability to access NASA content and resources through several mechanisms, including the state virtual schools. The proposal expands NASA reach as content expands, dramatically increasing access for any student by working through CCSSO's unique ability to provide the mechanism for states to work together, in support of Tactical Objective, Develop or Refine an Infrastructure and Disseminate NASA Content and Resources (p.24).

GOALS AND OBJECTIVES: As a next generation learning system, the VLM will work across states in partnership with state virtual schools and local schools to engage students with a passion for space science in a multi-year STEM pipeline of rigorous study, in part by using NASA

education infrastructures, subject matter experts, mission content, education products, and partners. The VLM will be available to students regardless of their demographic or the resource limitations of their local school.

CCSSO and NASA share a goal to foster STEM learning and achievement among a more diverse population of students. Online learning has a unique capacity to foster positive interaction and collaboration because it relies upon the students, rather than the teacher, to share information, personal experience, and perspective in pursuit of understanding:[xxviii]

- Students collaborate based on interest, skills and knowledge, rather than grade level, age or attendance area
- Students have more opportunity to learn from, and support one another
- Online learning environments break down social and ethnic barriers that persist in traditional school settings
- Opportunities for multi-state, global, and public/private sector interaction bring students in contact with a much more diverse group of peers and adults
- Students are, in fact, digital natives. Technology is a natural "second language" for most.

The VLM design will be attractive to large numbers of students who do not thrive in traditional learning environments, due to its "game-like" nature – students are presented with a series of challenges or learning goals, have control over the amount of time they spend learning and the time of day or night, have opportunity to select their own path to pursue those goals, are allowed to use failure as part of the learning process without penalty, and experience success in increments along the way.[xxix] Students learning together will share similar interests and be in communication with experts who have made those interests their life's work. Students who experience traditional education as a system that is "broken" may experience the Virtual Learning Magnet as a new education reality that works.

Specific objectives are:

- Offer at least four online courses for students to earn high school credits in STEM studies in the context of space science. Offer at least two opportunities for online dual credit in STEM.
- Offer an interdisciplinary, independent study experience that engages students with authentic mission activities through collaborative technologies and participatory learning
- Present students with opportunities to learn about and experience emerging developments in STEM technologies and learning innovations through partnerships
- Leverage VLM resources, tools and strategies to help states develop STEM teaching capacity and quality

These goals and objectives can be accomplished because there is substantial opportunity for CCSSO, NASA and partners to use resources and influence to connect investments and initiatives in a systemic way:

- Value can be added to NASA education priorities to help states create an unbroken pipeline to college and career and to institutionalize new practices in STEM education more quickly.

- Value can be added to current and emerging NASA projects, including but not limited, to NASA's new Interdisciplinary National Science Program Incorporating Research and Education Experience (INSPIRE)[xxx]
- There is also opportunity to add value in a reciprocal way to other awards and investments in innovation made in response to the K12CG proposal. For instance, Delaware and CCSSO have discussed integrating content and instructional resources developed through the DI_NAMIC initiative into the VLM for distribution to other states and for use in VLM online courses. Delaware would supplement face-to-face DI-NAMIC instruction with VLM content, CCSSO and Delaware would partner around professional development needs of teachers in both content and pedagogy necessary to use this highly-contextualized content successfully.

The work of meeting challenges in STEM will require a strikingly different approach, hallmarked by unprecedented levels of collaboration among states, business and industry partners, and education organizations. To achieve these goals and objectives, states who wish to participate in the VLM will sign a Compact[xxxi], outlining responsibilities of the VLM, the state, the district, and the local school as regards curriculum, instruction, assessment, and student supports. In addition, learners will develop and be assessed for 21st century skills.

PROJECT CONTENT: All content in the VLM "content repository" will be available to any teacher in a traditional bricks and mortar school if that state has signed the compact for participating in the VLM. By making the latest in content from NASA and other partners available to teachers and students in any school from a single source, the proposal adds tremendous residual benefit for addressing the "retrofitting" needs mentioned earlier, even though this is not the focus of the proposal.

To address the emerging needs of the 21st century, the VLM proposes innovative, break-through approaches accompanied by the tools and techniques to make them work. **In addition to the aspects of the VLM described in Project Purpose, Proposed Work Meets Customer Needs**, aspects of the VLM relevant to Project Content are:

1. The VLM can offer students who are first drawn to space science studies an opportunity for engagement with NASA through the VLM, access to opportunities of which they might not otherwise be aware, such as INSPIRE, and the chance to participate in other NASA-sponsored experiences. Examples are The Discovery Education 3M Young Scientist Challenge, Students Take Over, Fundamental Aeronautics Student Competition, the Thatcher Scholars, and Odyssey of the Mind.
2. Both formative and summative assessments will be used in the VLM. Two types of summative assessment are pivotal.
    - Formative assessments help students adapt study habits and learning behaviors to increase progress. Formative assessments help teachers adapt and individualize instruction.
    - A sequence of "Readiness Assessments" are used to validate a student's readiness for the learning ahead. In the case of the Physics course, for example, the "Readiness Assessment" will be proof of mathematics learning comparable with completing Algebra

II, and a Lexile[xxxii] reading score that will ensure success in comprehending reading for the course.

- A "Gateway Assessment" is used to validate student learning all along the way. Once a student demonstrates deep understanding of a concept, an idea, a Big Idea, or a course, the assessment validates that s/he is ready to go on to the next level of learning. All of a student's evidence of learning is collected in an electronic format in the "Learner's Evidence Repository" for subsequent use in building on or demonstrating understanding in higher levels of the same course or in another course.

3. Progression is based on clearly articulated learning goals. Students will be presented with standards-based rubrics and examples of student work at various performance levels.
4. As the VLM matures, learners will have opportunity to earn college credit through dual credit for at least 1/2 of their VLM courses and to become more aware of, as well as more competitive for, NASA-sponsored post-secondary opportunities.
    - Learners will graduate with an established relationship with postsecondary institutions where they can continue their specialized preparation.
    - The VLM will offer students the opportunity to continue and enhance engagement with NASA resources and NASA's mission as they earn high school credits and begin the transition to postsecondary education and career. Examples are the Annual CanSat Competition, NASA History Division Internships, University Design Contest in Exploration Systems, Tier 3 INSPIRE College Internships, and Art and Design Contests.
    - Tertiary learning opportunities as well as virtual and hands-on learning experiences are built into the fabric of the VLM approach. VLM students may participate in post-secondary internships with NASA or other partners, or may participate virtually or in real-time in a wide range of experiences overseen by VLM partners. An example might be participation in KySAT, a NASA-sponsored program for undergrad students to participate in micro-satellite design and launch.[xxxiii]
5. The VLM approach is systemic, but starts with the needs of the individual learner. The tools, strategies and approach will result in an education experience that is based on:
    - Highly modularized, dynamically-sequenced curriculum
    - Performance-based, rather than Carnegie unit, or seat time-based credentialing
    - Designed to take advantage of open-source, open architecture emergent additions
    - Based on high-value competencies, national standards, and international benchmarks
    - Delivered through individualized instruction
    - Including "stretch goals" for every learner
    - Designed for a high degree of relevance to academic and career goals
    - Leading through a continuum of learning to guaranteed credentials
    - Transferrable to higher levels of learning and credentialing
    - Undergirded by strong learner supports and
    - Including robust intellectual challenges
7. A consistent course architecture will be adopted.
    - Each course will be based on a series of Big Ideas with accompanying Essential Questions. These "Big Ideas" are key concepts in each course that are critical to knowledge development of the content (see example in Appendices)

- The uniqueness of the VLM lies in modularization and open architecture. Content for each of the Big Ideas will be housed in a content repository that will expand with contributions from NASA, other aerospace partners, public and private education partners, and, as previously mentioned, students.

In progressing from module to module, (See Appendix X) students will experience choice. In the physics course (Appendix Y), for instance, a student must begin with Kinematics and then complete Mechanics. After Mechanics, he/she may choose to enter Gravity or Energy and Momentum but must complete both before undertaking the four remaining modules. At this phase, the student must complete the four remaining modules, but may complete them in any order, or simultaneously.

Modules will present the Big Idea and provide opportunities for student learning and demonstration of learning. Each module will minimally contain a readiness assessment and a gateway assessment, lesson and supporting resources in a variety of formats and media, interactive discussion, problem sets and a lab. NASA content will be harvested and attached to elements of each Module, as needed. NASA content will derive from two categories: content produced specifically for educational purposes; and, primary source materials to which NASA has provided access for use in the VLM. Primary source materials include artifacts, or by-products, of actual mission activities. Examples are data sets from previous launches, video and images produced for astronaut training, audio from mission control activities, multi-media produced for release through commercial broadcasting channels, and models, blueprints and simulations. Students will be encouraged to explore other content resources, use them for learning, and share them with other learners.

All VLM courses and study experiences will use the structure for course development and learning environment that is described below. This approach was guided by research and models for mentoring and coaching online instructors and facilitators recently published by the North American Council for Online Learning: [xxxiv]

Course Teams: All courses will be developed and delivered using Course Teams. The Course Team consists of the Course Developer and 2 - 3 content experts who may become Course Leaders.

Course Developers: There will be a designated "Course Developer" for each VLM course. Course Developers will be the primary content experts accountable for academic integrity of the courses. They will be secondary or postsecondary faculty with demonstrated experience in traditional as well as virtual learning environments, and will possess appropriate certification and credentials. Course Developers will work closely with Course Leaders to respond to questions and requests for assistance regarding the curriculum.

Course Leaders: Course Leaders are certified teachers who serve as the “teacher of record” for transcription of student achievement for the local school. Course Leaders work with student coaches as well as the Course Developer and subject matter experts from public and private sectors. Course Leaders are assigned to courses (rather than students) and also serve as first tier

review experts for validating and tagging content for the content repository. Course Leaders are responsible for validating summative assessment results of VLM students.

Student Coaches will be assigned to each student on a learning team. Student Coaches will be responsible for supporting up to 20 students, and have primary responsibility for maintaining communication with the student, student's local school, and parents to ensure that students are engaged, motivated and making progress. Student Coaches will act as advocates for individual student achievement, work closely with students' local schools to share progress, and with Course Leaders to identify appropriate resources as well as responses to recognized needs for intervention. The student's primary communication on a day-to-day basis will be with the Student Coach. While Student Coaches will possess a high degree of familiarity with content in the course(s), it is very likely that Student Coaches will move with individual students from course to course.

Virtual Learning Magnet Facilitator: The VLM Facilitator is the person or persons at the sending school/state virtual school/other entity who is the primary point of contact between the school and the VLM. The role of the Facilitator is to ensure that students are advised about VLM opportunities, enrolled appropriately, and receiving the local supports identified in the state affiliation compact. The VLM Facilitator will also be the primary point of contact concerning student progress for the VLM Learning Team.

Learning Teams: A Learning Team may be made up of a Course Leader and up to 3 Student Coaches. Students will be supported by Learning Teams rather than assigned to a single teacher in pre-defined sections. A single Learning Team will generally support up to 60 students in a course.

Learning Window: A Learning Window of a predetermined length will be established for each course or Independent Study. The Window will establish the individual student start date and a corresponding "must-complete-by" date (e.g. 180 days) .Within the Window, open entry and open exit will be observed. It is the responsibility of the Student Coach to see that students do not fall behind, and also to encourage them to accelerate their pace in the course so that more learning may occur and be credentialed.

All adults engaged in the roles described above will function as members of a professional learning community to support VLM students. The VLM design calls on all members of the student support team to own the success of each student. It will also be the responsibility of this community to solicit and examine feedback from sending schools, parents, students, partners and NASA about the student experience. Their task will be to bring forward actionable recommendations and to identify the professional development needs of the VLM student support community.

Inherent in the Professional Learning Community is the notion of mentoring and coaching for members of the Learning Team. Mentoring and coaching will also be critical for State or local VLM Facilitators as a means to improve the ability to cause learning. There are several models and types of mentoring emerging in the online environment, as described in a recent NACOL

publication. The VLM will adopt a model that can be adapted to align with the needs of affiliating states, based on recommendations of the VLM Advisory Board, and that includes supports for state and local staff engaged with the VLM.

Participation in Independent Studies will be a key aspect of the Virtual Learning Magnet experience. Independent Studies will provide students with in-depth exposure to and the ability to participate in a particular aspect of an actual mission in the planning, execution or evaluation stages. Based on a student's demonstrated interest, ability to work as a contributing member of a team, content knowledge, and communications skills, the VLM (with guidance from NASA staff) will design introductory "professional experiences" to engage student in interdisciplinary research and problem-solving. Work products from the Independent Study experiences will contribute to mission objectives and will become an important part of the student's education portfolio. Students who wish to pursue an Independent Study must apply and be accepted. It is anticipated that most of these students will also be pursuing STEM credits through the VLM. However, based on NASA's needs and requirements, students who have participated in NASA programs outside the VLM will be able to continue engagement with NASA through this virtual environment. Examples are students who participate in on-ground summer institutes or internships and want to extend that experience.

Mentors will be assigned to students who have been accepted into an Independent Study. This pairing may be on a one-to-one basis or one mentor supporting a small group of students engaged in the same aspect mission activity. Mentors collaborate with a Course Leader to identify learning goals and objectives for the student, ensure that the student is making progress, and facilitate communication with a NASA liaison.

ANTICIPATED RESULTS: The most evident anticipated result is a new set of learners who use the resources, structures and networks of the 21st century to become the scientists, engineers, mathematicians and citizens who can meet the challenges of the new age. The content in the online courses, the interdisciplinary study experience, the opportunities to learn about and experience emerging developments in STEM technologies and learning innovations through partnerships and the leveraging of VLM resources, tools and strategies to help states develop STEM teaching capacity and quality are vital.

To achieve these results for learners, the VLM design is focused on continuous progress and transitions to next levels of learning, not only through the curriculum but also through high school to postsecondary studies, including community colleges and traditional four-year colleges and universities. The design includes deliberate engagement with community colleges in the states as well as national research and policy organizations such as the Community College Research Center at Columbia University.

CCSSO has targeted engagement with the community college system as a key strategy for attracting and engaging minorities and traditional under-represented learners in VLM studies. CCSSO relied heavily on the Bill and Melinda Gates Foundation "Post-Secondary Education +" [xxxv]initiative on social mobility to develop this strategy. Upon award, CCSSO will construct Memoranda of Agreement with community college systems for the purpose of offering online

dual credit STEM courses enhanced with NASA resources. The colleges will work as a dual credit consortium in the VLM, not duplicating offerings and agreeing to a consistent set of policies related to eligibility, fees, student supports and courses that are transferrable to a four-year degree.

Another anticipated result will be seen in the partnerships with four-year institutions, particularly research institutions and institutions with international connections, a critical link to business and industry. CCSSO is pursuing a partnership with the NSF-funded iLabs[xxxvi] initiative at Northwestern University and MIT, which would offer VLM Physics students the opportunity to conduct experiments on research equipment in labs remotely. CCSSO will work with sector partners to identify critical pathways and opportunities for VLM learners. These partnerships support Tactical Objective, Develop or Implement Projects Activities, Modules, Approaches that Bridge between High School and Postsecondary Education (p 24).

As an example of how this will be achieved, the Virtual Learning Magnet will partner with the Northwestern University Office of STEM Education Partnerships "Defining Climate Change Analytical Literacy at the Secondary and Post-Secondary Levels" initiative. Northwestern will develop GIS-based activities that use NASA remote sensing data and teach students how to analyze the data related to climate change. NWU's ultimate goal is to establish a baseline of "analytical literacy" that all students should have in understanding and working with spatial data to study climate change. Since NWU's goal is to examine literacy among both high school students and college freshmen, advanced VLM students will have the opportunity to be assessed at the college level.

DELIVERABLES (see corresponding elements of the Timeline with references to these numbers)

1. 3 science courses (including Physics), 1 mathematics course (Algebra II) for secondary students and an Independent Study course will be developed for inclusion in the VLM for Space Science and Mathematics
2. 2 dual credit science courses will be developed in conjunction with affiliating tertiary institutions.
3. Professional Development modules will be developed for use by Course Developers, Course Leaders and Student Coaches
4. The VLM Content Repository will be established and populated to electronically "house" all content for the VLMs
5. Readiness Assessments and Gateway Assessments will be developed to ensure that students are prepared for success and are ready to move on to subsequent learning opportunities.
6. Development of an innovative, organic, collaborative team approach to course development, course delivery, as well as student advocacy and support
7. A system specifically designed to lead to the success of each individual learner. Students persist with a course until they are successful and ready to move to the next level of learning.

July – August 2009	Advisory Board meets.[6] Using data from spring '09 Proof of Concept, complete enhancements to the Physics

	course[1] and Independent Study model[1] Recruit states for fall '09, assist states with student recruitment, provide professional development[3] to state/local facilitators and planning for implementation Identify and train instructors for fall '09 [3;] Content Repository population continues[4]
September – December 2009	Pilot the VLM Physics and Independent Study[1]; open to all states. For planning purposes, estimate 500 students[5]. Content Repository population continues[4] Launch pilot of state virtuals as secondary distribution network for physics course[1]: whole course direct instruction inside the state; team teaching and student collaborations across state virtuals; training of local teachers[3] to use content repository[4] to supplement face to face instruction (blended model). Present session on Pilot at 2009 Virtual Schools Symposium[xxxvii], November, and hold meeting on VLM with interested states on plans for expansion. Collect formative feedback data, ongoing. Share with Advisory Board. Refine and adjust accordingly (content, instruction and policy) for spring '09. Consult with external evaluator. (This task repeats every fall, spring and summer.) Identify additional states for spring '09, assist states with student recruitment, and provide professional development[3] to state/local facilitators and planning for implementation
January - May 2010	Launch at least one newly developed course as beta and expand independent study opportunities [1;] Content Repository population continues[4] According to their individual learning plan, some students will continue from fall as new students enter to begin learning[7]. Expand numbers of participating states, students and teachers Advisory Board meets[6] Expand collaborations with state virtuals[6] based on data from fall '09. For planning purposes, estimate three to five additional state programs. Identify additional states for summer and fall '10, assist states with student recruitment, provide professional development to state/local facilitators and planning for implementation Identify and train instructors for summer and fall '10[3]
June – August 2010	Some students continue in established VLM courses[7] Offer limited summer learning experience, including beta for new courses[1, 2] being launched in fall as well as independent study[1] Offer jump-start learning for at-risk students entering in fall[5], through state virtuals, community colleges and/or VLM direct delivered[6] Expand collaborations with state virtuals based, including expansion of independent study[1] to include teams of students from across states. Content Repository population continues[4] For planning purposes, estimate ten to fifteen additional state programs. Offer online professional development for teachers [3] who will use VLM blended model

September – December 2010	VLM continues expansion with at least four-credit opportunities[1] and enhanced independent studies[1], both individual and group, and expanded dual credit[2.] Hold a Preconference one-half day session and a general session on VLM at 2010 Virtual Schools Symposium , November. Number of students, states and instructors continues to expand. For planning purposes, estimate 5,000 students Advisory Board meets[6] According to their individual learning plan[7], some students will continue from '09 – '10 as new students enter to begin learning[5].
January - June 2011	Launch newly developed courses and expanded independent studies[1, 2;] Content Repository population continues[4] According to their individual learning plan[7], some students will continue from fall as new students enter to begin learning [5] Advisory Board meets[6] Evaluation of K12 CG will be delivered to NASA by 30 June 2011

SUSTAINABILITY

The Virtual Learning Magnet has to work at the nexus between the focus on school accountability and the need to change the education context to one that focuses on each child. An underlying principle is the notion that there is value to be created for all participants and partners at lower total cost and less loss of learning opportunity to the system. The recognition of that "value chain" is what will make the Virtual Learning Magnet ultimately sustainable. This "value add" concept underlies the focus in the VLM design and this proposal, on collaboration among, formal and informal education partners, and the leveraging of existing and future NASA investments. Because resources at all levels are so constrained, as another element of the "value add", we strongly encourage NASA to help foster integration of content and instructional resources created as a result of other winning proposals into the VLM as a secondary benefit to all.

From a more practical, budgetary perspective, CCSSO is developing a funding model that will isolate costs associated with the VLM infrastructure and the basic operations costs associated with the enrollment of a student. The goal of the model is to support the more stable recurring costs with grant funds and to recover costs associated with student enrollments through a system of fees and sponsorship. The funding model will be revised and refined over time as data help us purify costs and identify opportunities for efficiency in procurement and service delivery. Also to be figured in will be opportunities for revenue generation through the offering of supplementary services, perhaps in professional development, on a modest for-fee basis. CCSSO's goal is a sustainable funding model which will allow the VLM to continue without grant funding.

Sustainability strategies will also rely heavily on strategic partnerships, guided by a seven to nine member VLM Advisory Board. CCSSO has requested and secured participation on the VLM Advisory Board from the leadership of two key organizations and a state chief: Susan Patrick,

President and CEO, North American Council for Online Learning (NACOL)[xxxviii]; Jim McMurtray, Executive Director, National Alliance of State Science and Mathematics Coalitions (NASSMC)[xxxix]; and, Dr. Steve Paine, Superintendent of Schools, West Virginia. These three individuals will advise CCSSO on the recruitment of remaining members.

DISSEMINATION

Dissemination goals for the VLM include teachers and schools in affiliated states, those states' virtual schools, and faculty in affiliated community colleges who adopt NASA-infused VLM content and/or VLM design principles to meet educational needs. The goals also include affiliated states that change state-level policy to increase ubiquitous access to online learning opportunities. The challenge is to facilitate and be able to measure widespread adoption using baselines and annual targets in ways that are consistent with NASA's strategic and tactical goals as well as CCSSO's goals for leading transformational change. CCSSO will use engagement, collaboration and participatory learning strategies to examine how resources and strategies developed as a result of this award are impacting individual student learning as well as changing teaching practice. This will require close collaboration with state professional development initiatives as well as integration and sharing of knowledge about VLM and STEM teaching and learning. This is a critical piece of CCSSO's overall strategic initiative, "Systems of Support for Student Learning", in which all state chiefs are partners.

EVALUATION

The VLM project will utilize multiple mechanisms, and both internal and external processes, to evaluate and provide feedback to the development team. A key strength of an online learning effort such as VLM is that new courses will be delivered via Course Management System (CMS) software that can provide extensive data on the students in those courses, including demographic information, details about learning activities they construct for themselves, content accessed, test performance at different points in the course, and competencies demonstrated at course end. A member of the project external evaluation team—Terry Hibpshman, a psychometrician and database developer/analyst currently with the University of Kentucky—will assist project managers in constructing a data system that will enable them to review monthly the most useful information about students and their experiences in the courses, so that software developers and Course Team members can make appropriate adjustments. This system will provide the primary and most direct feedback on students, their performance, and the overall impact of the VLM on the target population. Of particular interest will be the diversity of students enrolled, how they became enrolled, their curricular opportunities outside of the VLM, the role of adults in assisting students in courses, the content they study the competencies they demonstrate, and their plans for the future. In short, the project will build into the CMS extensive data gathering capabilities so that the processes of course taking will automatically provide basic information about program performance.

The project will use a three member team based in Kentucky to provide external evaluation. The team lead will be Dr. Stephen Clements, and he will be assisted by Dr. Patricia Kannapel and Terry Hibpshman. All three have extensive experience in education evaluation and policy research. The evaluators will work with the development team on analysis and use of the data from the CMS, but will also design an inquiry process—relying as mentioned earlier on the U.S. Department of Education's new guidelines for evaluating online learning—that focuses on barriers to and facilitators of participation by students in VLM courses, and on the nature and outcomes of the collaboration envisioned in this project across the VLM, traditional schools, community colleges, and the CCSSO. In terms of the former, the team anticipates strategically choosing course-taking sites based on CMS data, and interviewing Student Coaches, Learning Team members, and educators from traditional schools supplying students to examine strengths and weaknesses of the design. Similarly, the team will target sites that feature dual credit courses to assess the level of collaboration and interaction across institutions. The success and scalability of the project will depend upon the functionality of these program mechanisms, and the external evaluation will provide critical feedback on these features of the design.

MANAGEMENT

The development team has three tiers of members. In the first tier are Dr. Lois Adams-Rodgers, the PI, and consultants Tom Welch and Linda Pittenger. These three have guided the development of the VLM concept and were responsible for defining and designing the "VLM beta", the Proof of Concept that preceded this grant. These three have taken primary responsibility for management of the VLM, from design to execution. This group consults bi-weekly with the Executive Director of CCSSO, Gene Wilhoit, a former Commissioner of Education in Kentucky and Arkansas. A second important tier of team members includes the Chief State School Officers who are members of CCSSO. The genesis of the VLM began two years ago when the Chief State School Officers discussed, as an agenda item of their annual meeting, the need for a unique collaboration for virtual learning that could benefit students in each of their states and add value to existing STEM and virtual learning initiatives. The VLM design, as presented in this proposal, has evolved since then with regular input from the Chief State School Officers and their Deputies. A third, but very important tier of members is a wide-ranging and increasingly diverse group of individuals and organizations that understand the potential for a significant impact. These partners function as informal advisors and thought leaders, providing valuable feedback and guidance. The group include directors from leading state virtual learning programs, the heads of national education advocacy non-profits, administrators and faculty from post-secondary institutions, and of course, online and on ground teachers of math and science from around country. The third tier also includes leading CCSSO Business Partners who have joined in extensive conversations and meetings to help the first tier team members design the activity for maximum impact. It is from this third tier that most members of the VLM Advisory Board will be drawn, as evidenced by the three named to date. The senior management team of Adams-Rodgers, Welch and Pittenger bring unique qualifications, capabilities and experiences to the project. Adams-Rodgers, a former State Deputy Commissioner, has worked with CCSSO's members for over five years and has strong relations with the Chiefs and other key personnel in the States, a vital requirement for wide-spread collaboration across the country. This relationship is manifested in the attached letters of commitment to the VLM concept from Chiefs. Welch brings a strong curriculum background as

outstanding teacher, principal and state curriculum consultant to the project as well as experience with and connections to a national network of teachers from all disciplines, administrators and state-level curriculum designers. Pittenger, a pioneer in the world of educational virtual learning initiatives, brings technical expertise, business acumen and deep connections into virtual learning programs and key personnel from around the country.

A singular characteristic of the VLM is the level of collaboration with other projects, institutions, professional societies, and other partners. This project is designed to be "organic". To ensure maximum impact for students from around the country, the project's design is dependent on extensive collaboration. Many of these collaborative relationships, with state virtual schools, post-secondary institutions, professional organizations and business partners have already been set up in anticipation of the launch of the VLM. The combination of the talents and experience of the first-team tier members as well as the extensive thought and groundwork that have been laid for this project over two years with input from second and third tier partners, combines with the experience in working with NASA leadership in the preparation of the Proof of Concept to maximize the likelihood that the effort will result in an efficient and productive effort.

PRIOR SUPPORT

Adams-Rodgers, Welch and Pittenger have strong backgrounds from their current and previous positions in supporting STEM instruction and/or learning. Further examination of their attached bios will confirm this commitment. In their respective administrative roles at the state as well as at the local level, STEM instruction and learning was a priority. Background and success in prior work function as precursors for current work on the "beta" version of the VLM - the Proof of Concept sponsored by NASA. Ready to enroll students in January of 2009, the Proof of Concept was designed by Adams-Rodgers, Pittenger, and Welch in close consultation with and design input from leading NASA education experts at the national level. It contains many of the key elements of the VLM, including: "harvesting" and repurposing of existing, high-quality NASA content; a content-repository; readiness and gateway assessments; establishment of a learner evidence repository; opportunities for regulated learner control and choice over pacing and specific content; non-linear curricular approach around a set of "Big Ideas"; NASA mission-focused independent learning opportunities; and, close collaboration with NASA education personnel.

As an example or prior work, Pittenger and Welch collaborated on implementation of a performance-based, technology-enabled, team taught "Vanguard" math/science initiative in a Kentucky school district as a demonstration site for aspects of the state Board's secondary reform agenda. Several design elements of the VLM are based on that experience. Students in Vanguard achieved in math and science at levels well above the control group of students experiencing traditional math and science instruction in the district. Also, there were fewer disciplinary referrals and higher average attendance levels among Vanguard students.

SUMMARY

In summary, the Virtual Learning Magnet for Space Science and Mathematics represents a bold next step for CCSSO, for NASA and for all segments of the education and business communities. It bears little resemblance to any past programs or initiatives for any of our institutions. It is truly a 21st century initiative, focused on taking advantage of the present and the future, rather than focusing on overcoming the shortcomings of our past. It is designed to bring together the vast resources, both current and emerging, of a wide ranging set of partners, including the State Education Agency (SEA) in every state, state-level virtual schools, postsecondary partners, and an expanding set of governmental partners such as NASA, the Smithsonian and others. It is designed to begin a thoughtful, seamless integration process that will eventually reach from elementary school learners through post-secondary institutions. It is also designed to capitalize on the resources of the private sector which have acknowledged needs in STEM-related fields, and critical needs in workforce development.

Most importantly, using 21st century technologies, systems, resources and networks, the Virtual Learning Magnet for Space Science and Mathematics lays the groundwork for doing what has never before been attempted. It represents a bold commitment that acknowledges that by working together across state lines, across agency boundaries and beyond previously accepted barriers in industry, this country can provide and deliver to any learner, anywhere at any time, the resources, support and commitment to make each of them a success.

Biographical Sketches:

Principal Investigator -- Dr. Lois Adams-Rodgers, Deputy Executive Director, Council of Chief State School Officers

Dr. Lois Adams-Rodgers joined the Council of Chief State School Officers after a 32-year career as a Kentucky educator at a variety of levels. She has served as a teacher, elementary and middle school principal, special education program coordinator, assistant superintendent, superintendent of schools, associate professor and director of programs at two universities, a state department official in multiple leadership roles, serving as deputy commissioner in the Kentucky Department of Education under three commissioners of education. She holds a bachelor's degree, master's degree, and doctorate of education from the University of Louisville.

Dr. Rodgers serves on a variety of boards, including the National Association of State Science and Math Coalitions, Appalachian Math and Science Partnership, National Community Education Association, the Steering Committee of the Arts Education Partnership, and the Center for Research, Evaluation and Advancement of Teacher Education.

APPOINTMENTS AND BOARDS OF DIRECTORS

National Advisory Board, Appalachian Math and Science Partnership
National Advisory Board, NASSMC
Co-chair, Kentucky Reducing the Achievement Gap Task Force
P12 Staff to Kentucky P16 Council
League for Innovation in Community College System Advisory Council
Appalachian Educational Lab Board member and Chair (2002-03)
Co-Principal Investigator, National Science Foundation Systemic Science Initiative, PRISM,
Partnership for Reform in Science and Mathematics
Task Force on Public Education, Teaching and Learning Issues Group, Resource Person
National Science Foundation Projects, State Coordinator
Appalachian Rural Systemic Initiative (ARSI) Management Team
Kentucky Math Coalition, Chair
Chief State School Officers Study Commission, Executive Committee
Task Force on Children in Placement
Task Force on Health Start Models
State Interagency Council, Commissioner's Designee
Kentucky Community Service Commissioner, Commissioner
KIRIS Board of Review, Internal Chair
Board of Overseers, University of Louisville
Partnership for School Reform, Speaker's Bureau
Juvenile Justice Cabinet Advisory Council
Forward in the Fifth Board of Directors

Multi-cultural Advisory Council
Minority Educator Recruitment and Retention Advisory Board
Character Education Advisory Council, Chair
Human Development Institute, Model Change Project, Board of Directors
Commissioner's Designee to:
Education Professional Standards Board
Workforce Partnership Council
Governor's Scholars Board
Cabinet for Families and Children Cabinet Level Welfare Reform Work Group
Education Coalition
Cabinet for Human Resources State Design Team
State Interagency Council
Cabinet for Human Resources Children's Initiative
National Council of State Legislatures "Job for the Future" Project – Kentucky Team
Bluegrass IMPACT Initiative for Children with Emotional Disorders
Bluegrass Tomorrow and Jessamine County Tomorrow Boards
Kentucky Academy of School Executives (KASE) Advisory Board
Legislative Committees of:
Kentucky Association of School Administrators, Ohio Valley Association of School Administrators, Kentucky Association of Elementary School Principals, Kentucky Association for Supervision and Curriculum Development
Resolution Committees of:
Kentucky Association of School Administrators, Kentucky Association of Elementary Schools Principals
Awards Selection Committees of:
Kentucky Association of School Administrators, Phi Delta Kappa, Louisville Chapter
Kentucky Institute of Women in School Administration Steering Committee and invited to join first class
Leadership in Administration (LEAD) Advisory Council, "Women and Minorities"
American Association of School Administrators Resolutions Committee and Member or Alternate Representative to the Delegate Assembly for the past 6 years
Kentucky Coalition for School-Age Child Care Board of Directors
Governor's Task Force on Child Abuse Reporting and Discipline
Child Service Demonstration Center Advisory Committee
Region VI Champions Against Drugs Regional Action Team
Legislative Study Committee on Education, Arts and Humanities Cabinet
KET STAR Satellite Study Committee
Commissioner's Advisory Council
KET County Coordinator
Seven Counties Services Board of Directors, Rural Committee Chair
Community Employment, Inc. Board of Directors and Chair

Tom Welch

Tom Welch holds degrees from Asbury College and the University of Kentucky. He has served in a variety of education-related positions, first as a classroom teacher (Kentucky Teacher of the Year, 1992), curriculum consultant at the Kentucky Department of Education, and as principal of East Jessamine High School in Nicholasville, where for six years he was a teaching principal, insisting that all administrators also teach one class every day. During his time as principal, he taught mathematics, speech, history, humanities, French and a class in entrepreneurship.

Welch also proposed and oversaw the implementation of one of the state's most innovative programs for systems change at the high school level. The "Vanguard" program was a multiyear program in which a diverse group of students worked with mathematics, science, social studies and English teachers in a performance-based credit environment. The program was specifically designed to take advantage of a high degree of differentiation for each learner. Supported by a grant from the Kentucky Department of Education and then-Commissioner, Gene Wilhoit, the students were each issued their own laptop for 24/7/365 access to learning resources. The program proved to be very successful on several fronts. First was the direct impact on student learning as many students took advantage of the opportunity to accelerate and earn more credits in a given time than would have been possible in adhering to the traditional Carnegie-unit, or time-based paradigm. At the other end of the spectrum, failure was eliminated for VLM students since each was given the individual time necessary to meet clearly articulated standards which were assessed with common end of course assessments.

Always an ardent revolutionary when it comes to school reform, Mr. Welch left East High to oversee the education initiatives of Kentucky's Economic Development Cabinet's Office for the New Economy. In that position Welch worked with educators and business leaders from around the state, with a particular focus on the STEM-related initiatives that were at the heart of the mission of the Office for the New Economy. He was also instrumental in the formation of a group of secondary, post-secondary and business leaders. This group, called "Think-Link" focused on coordination of common efforts ranging from communication of a common message about the impact of a STEM-ready workforce on the economic future of the Commonwealth, to efforts to see that students who lived in underserved areas had the opportunity for virtual learning. From there he transitioned to the Kentucky Department of Education where he was a consultant in Secondary Redesign Initiatives in the Division of Secondary and Virtual Learning. During his time in the Division, Welch helped oversee the development of an online course in Mandarin Chinese. His passion for student learning and his belief in the need to reinvent the secondary experience for each student have motivated him in the work he has been engaged in as a full-time consultant working around the nation since leaving the Department of Education in 2006. In that capacity he conceived and has helped direct the Proof of Concept for the Virtual Learning Magnet for Space Science and Mathematics.

Linda Pittenger

Linda Pittenger retired from the Kentucky Department of Education (KDE), as Director of Secondary and Virtual Learning, in May 2008 to join CCSSO as a consultant for the Virtual Learning Magnet. During her career at KDE, she served as Director of the Kentucky Virtual Schools, led the Kentucky Board of Education initiative on middle and high school reform, worked as state department coordinator for Kentucky's National Math and Science Initiative and the American Diploma Project, served as project manager for Kentucky's National Governors Association Honor States Grant on high school redesign, and as executive sponsors for the state's longitudinal data systems implementation and Knowledge Management Portal. She is a founding Board member of the North American Council for Online Learning, has served on the National Repository of Online Content National Advisory Board and the National High School Center Advisory Board. Ms. Pittenger serves on Blackboard's K12 National Advisory Board. Currently, she is also under contract with the Kentucky Community and Technical College System where she advises on P16 college and work readiness initiatives and the development of online transitional content for under-prepared students among the 16 colleges. Linda's background is in information policy and education technology.

Appendix A

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[i] *The Council of Chief State School Officers (CCSSO) is a nonpartisan, nationwide, nonprofit organization of public officials who head departments of elementary and secondary education in the states, the District of Columbia, the Department of Defense Education Activity, and five U.S. extra-state jurisdictions. CCSSO provides leadership, advocacy, and technical assistance on major educational issues. The Council seeks member consensus on major educational issues and expresses their views to civic and professional organizations, federal agencies, Congress, and the public. www.ccsso.org*

[ii] *The Nation's Report Card, National Center for Education Statistics, Fast Facts, http://nces.ed.gov/fastfacts/display.asp?id=38.*

[iii] *The Nation's Report Card, National Center for Education Statistics, Fast Facts, http://nces.ed.gov/fastfacts/display.asp?id=38.*

[iv] *National Governors Association, Innovation America: Building a Science, Technology, Engineering and Math Agenda, http://www.nga.org/Files/pdf/0702INNOVATIONSTEM.PDF.*

[v] *Business Tools for Better Schools Toolkit, Achieve, Inc, http://biztools4schools.org/ The toolkit was created and is maintained by Achieve, Inc. with support from the GE Foundation and the Business Roundtable.*

[vi] *Business Tools for Better Schools Toolkit, Achieve, Inc, http://biztools4schools.org/ Data from NCES Digest of Education Statistics.*

[vii] *Business Tools for Better Schools Toolkit, Achieve, Inc, http://biztools4schools.org/ .*

[viii] *Building a Better NASA Workforce, Committee on Meeting the Workforce Needs for the National Vision of Space Exploration, National Research Council, 2007.*

[ix] *Distance Education in Elementary and Secondary Public School Districts, 2005, U.S. Department of Education National Center for Education Statistics.*

[x] *Schools and Staffing Survey: 1999-2000, U.S. Department of Education.*

[xi] *The Silent Epidemic: Perspectives on High School Dropouts, Bill and Melinda Gates Foundation, 2006. www.silentepidemic.org.*

[xii] *Toward a New Golden Age in American Education: How the Internet, Law and Today's Students Are Revolutionizing Expectations: National Education Technology Plan, 2005, U.S. Department of Education.*

[xiii] *What We Can Do: A Forty Year Update of the National Advisory Commission on Civil Disorders, Linda Darling-Hammond, Stanford University Center for Opportunity in Policy and Education, 2008.*

[xiv] *Ending The Silent Epidemic, A Ten Point Plan, Bill and Melinda Gates Foundation. www.silentepidemic.org.*

[xv] *Laboratories of Reform, Virtual High Schools and Innovation in Public Education, Education Sector Reports, Bill Tucker, 2007.*

[xvi] *Synthesis of New Research on K12 Online Learning, North Central Regional Education Laboratory/ Learning Point Associates.*

[xvii] *Synthesis of New Research on K12 Online Learning, North Central Regional Education Laboratory/ Learning Point Associates.*

[xviii] *What Can Virtual Learning Do for Your School, Adam Newman, September 2003, Eduventures.*

[xix] *Keeping Pace with K12 Online Learning 2070: A Review of State-Level Policy and Practice, John Watson, Evergreen Consulting.*

[xx] *Virtual Schools: Planning for Suceess, Zane Berge and Tom Clark, Teachers College Press, 2004.*

[xxi] *Disrupting Class: How Disruptive Innovation Will Change the Way the World Learns, Clayton Christensen, Curtis Johnson and Michael Horn, McGraw-Hill, 2008.*

[xxii] *New American Dilemma, National Action Council for Minorities in Engineering, May 2008, http://www.nacme.org/news/americandilemma.html.*

[xxiii] *Post-Secondary Education +: An initiative to dramatically expand social mobility in America, Bill & Melinda Gates Foundation, February 2008.*

[xxiv] *Post-Secondary Education +: An initiative to dramatically expand social mobility in America, Bill & Melinda Gates Foundation, February 2008.*

[xxv] *Monterey Institute for Technology in Education, 2008, www.montereyinstitute.org*

[xxvi] *Evaluating Online Learning: Challenges and Strategies for Success, Innovations in Educaton Series, United States Department of Education, July 2008.*

[xxvii] *The State Collaborative on Assessment and Student Standards (SCASS), of CCSSO, provides leadership, advocacy and service in creating and supporting effective collaborative partnerships*

through the collective experience and knowledge of state education personnel to develop and implement high standards and valid assessment systems that maximize educational achievement for all children

[xxviii] *Promising Practices in Online Learning: Socialization in Online Programs, John Watson and Butch Gemin, North American Council for Online Learning, September 2008.*

[xxix] *For discussion of the impact of digital media on learning, see The Ecology of Gaming: Connecting Youth, Games and Learning, edited by Katie Salen, John D. and Catherine T. MacArthur Foundation Series on Digital Media and Learning, Massachusetts Institute of Technology, 2008.*

[xxx] *http://www.nasa.gov/audience/forstudents/postsecondary/programs/INSPIRE_Project.html*

[xxxi] *At the 2008 Spring Deputies Leadership Conference, CCSSO presented a draft state affiliation Compact for state review. The Compact delineates CCSSO, state-level, district-level, and school-level responsibilities for participation in the Virtual Learning Magnet with an emphasis on a cohesive system of student supports and a primary point of contact for interaction with the VLM at every level.*

[xxxii] *The Lexile Framework for Reading is a scientific approach to reading and text measurement. There are two Lexile measures: the Lexile reader measure and the Lexile text measure. A Lexile reader measure represents a person's reading ability on the Lexile scale. A Lexile text measure represents a text's difficulty level on the Lexile scale. When used together, they can help a reader choose a book or other reading material that is at an appropriate difficulty level. www.lexile.com.*

[xxxiii] *KySat is the component of Kentucky Space involving the design, build, launch and ground operation of small satellites and other related spacecraft. KySat trains and supports students in the dynamics of spacecraft design, payload development, launch and the operation of small satellites and related spacecraft (including near-space) as a means of extending science, technology, engineering, education, innovation and entrepreneurship. Once achieving orbit (or sub-orbit) KySat will be made available at no cost to schools, students, parents, etc. for educational purposes and applications. KySat will involve an ongoing series of satellite design, build and launch missions -- each with varying scope and complexity. http://www.kysat.com/home.aspx*

[xxxiv] *Online Teacher Support Programs: Mentoring and Coaching Models, North American Council for Online Learning, October 2008. http://www.nacol.org/docs/NACOL_OnlineTeacherSupportPrograms08-lr.pdf*

[xxxv] *Post-Secondary Education +: An initiative to dramatically expand social mobility in America, Bill & Melinda Gates Foundation, February 2008.*

[xxxvi] *iLabs, Massachusetts Institute of Technology and Northwester University, http://icampus.mit.edu/iLabs/, **Labs** is dedicated to the proposition that online laboratories – real laboratories accessed through the Internet - can enrich science and engineering education by greatly expanding the range of experiments that students are exposed to in the course of their education. Unlike conventional laboratories, iLabs can be shared across a university or across the world. The iLabs vision is to share expensive equipment and educational materials associated with lab experiments as broadly as possible within higher education and beyond.*

[xxxvii] *The Virtual Schools Symposium is sponsored by the North American Council for Online Learning annually. It is attended by state, local and regional virtual school administrators, online instructors, representatives of national education organizations, and many researchers. Participation is increasing rapidly. 2006 attendance was 600; 2007 was 800; and, 2008 attendance was just over 1200.*

[xxxviii] *Susan Patrick, President and CEO, North American Council for Online Learning, http://www.nacol.org/about/president*

[xxxix] *http://www.nassmc.org/about.html*

The design of the Virtual Learning Magnet for Space Science and Mathematics, and many of the tools, techniques and strategies contained in this Proposal draw upon best practice studies and research conducted by the North American Council for Online Learning, including but not limited to the Promising Practices Series (all available from www.nacol.org):

- *Blended Learning: The Convergence of Online and Face-To-Face Education*
- *Using Online Learning for Credit Recovery and At-Risk Students*
- *Socialization in Online Programs*
- *Funding and Legislation for Online Education*
- *Oversight and Management of Online Programs: Ensuring Quality and Accountability*
- *A Parents' Guide to Choosing the Right Online Program*

Also,

- *Goals, Guidelines, and Standards for Student Scientific Investigations, Kemi Jona and John Adsit, North American Council for Online Learning, 2008.*