Executive Summary

There is a human capability emergency pending within the United States. Studies show that the next generation workforce in the US will be smaller than previous ones and the number of retirees is expected to increase over the next 5 to 10 years. If the United States wants to maintain its global competitive position in business, healthcare, and electronics it will need unprecedented levels of talent, creativity and innovation. The question is: what are we doing today to enable tomorrows US workforce to meet the needs of this global competitive landscape?

The reality is, today's US students are falling short in grades and benchmark assessments related to core knowledge needed to be minimally successful on the collegiate level. This is specifically prevalent in the areas of math and science.

Laboratory Chicago 2020 is a call to arms around this looming crisis. How should we be preparing our students? What are conditions and challenges today? How can we take on this seemingly overwhelming issue of how math and science is taught and equipped within our Chicago public school system?

We started to tackle this by bringing together a group of Science, Technology, Education and public experts to discuss what the future of the science lab should look like in Chicago. The key messages from this symposium include:

- The practice of scientists involves laboratory work.
- For students to be prepared for college and future careers, the study of science should involve laboratory work.
- Defining what laboratory work is, and the role of technology within the lab, is a difficult process.
- The inequities between facilities within the Chicago Public Schools (CPS) should be eliminated. CPS students should have facilities to learn science comparable to the rest of the state.
- It's necessary to consider all aspects of a system of support for science education and integrate these systems. This includes the physical construction of labs, teacher training, curriculum, equipment, technology, and finances and management.
- Ongoing data collection and analysis of work in progress is important to evaluate and learn from work.
- The design of labs should focus on flexibility, so that one space can be used for many different purposes.
- The amount of capital infrastructure still needs to be determined, but probably a configuration that's less costly than our current model.

What is Laboratory Chicago 2020?

Symposium arranged by:

The Chicago Public Schools (CPS) has committed approximately $30 million of capital improvement funds over the next five years to refurbish the high school science laboratories. It is clear that this will not be enough. Estimates indicate that an additional $90 million over the next five years will be needed to bring all high school laboratories within the Chicago Public School system to the same operating level. Laboratory Chicago 2020 is the campaign that intends to provide all CPS high school students the opportunity to learn the minimum amount of science individuals will need to be productive citizens within their current and future communities.

The Symposium

Laboratory Chicago 2020, in conjunction with the Teachers Academy for Mathematics and Science (TAMS) and sponsored by the Chicago Community Trust, collectively met in June 2004 to address the question: "What should the high school science laboratory of the future look like?" A collection of volunteer experts from the fields of Science, Technology, Education and the Public Sector were gathered to provide input towards an answer to this question. The opinions, suggestions and related information produced in this session are summarized and published in this white paper with the intent to drive actionable next steps to achieve the common goal of the campaign – to provide all Chicago Public School students with the facilities and support to achieve a high quality science education appropriate for the 21st century.

Session Summary

The symposium involved two sessions which emphasized the current and desired future states of the Chicago Public School Laboratories. One of the main conclusions of the session emphasized that the initiative will need to strike the right balance between fixing inequities that currently exist from school to school and building brand new labs in charter schools.

Guiding Principles & Key Ideas

The purpose of this session was to gather input and collect the best thinking towards achieving campaign goals. There were various ideas presented and supported through group discussions. These ideas collected should act as guiding but living principles to the program going forward. It is expected that this list will continue to be refined and modified as the program itself evolves.

- **Collaboration** - labs and approaches to teaching science must support collaborative learning and collaborative teaching.
- **Redefine "lab"** – there is a flexibility to what constructs a physical lab and that focus should be placed more on the intended learning outcomes such as inquiry and investigation and how that can be accomplished outside of the classic or typical laboratory setting
- **Relevance** – it is of great importance to provide effective math and science programs as it relates to the motivation of students
- **Teacher Development** – good teachers are effective despite laboratory shortcomings but are often not the recipients of available budget.
- **Technology** – provides the opportunity for students to explore data and aspects of the natural world in a simulated environment. While many experiences should not be done virtually, many can be.

- **Basics are Important**. – Science laboratories and classrooms need regular access to basic equipment and manipulatives to provide a modern education for students. Opportunities for students to use high end tools (i. e. fume hoods) should be should exist, but do not need to be available continually.

Implications

Drawing from the list of guiding principals produced, there are a number of possible action items that can be followed up on in an effort to drive the development and reconstruction of the labs, but to also provide support to the fund raising initiatives needed to meet the $90M budget gap. As with the guiding principals, the implications of this initiative will change over time as ideas are refined and more CPS realities are factored into the equation. An effort has been made to group ideas logically to the areas on which they are related.

- **Labs**
  Laboratory design should provide:
  - Context for team learning (e.g. modeling as a best practice)
  - Flexibility and modularity (may be used across multiple disciplines)

  Based on this design:
  - Redefine minimum lab standards to focus more on flexibility and basic exploratory equipment.
  - Assess all CPS schools against that minimum
  - Include teacher input for lab improvements in each school

  To realistically deliver and bring schools to a consistent CPS wide minimum:
  - Share labs across classes (wet/dry labs) where possible
  - Rehabilitate current labs to meet established minimums
  - Explore possibilities of outsourcing lab set-up and ongoing maintenance to corporate organizations who have experience and could potentially serve as after-school to work programs(e.g. Abbott, Baxter)

- **Teachers**
  There is a strong need for teacher development around laboratory science. The goal of this development will enable teachers with different approaches and styles enabling them to use available resources and increase student retention.
  - Enable teachers to enact the CMSI-designated instructional materials, with a particular focus on the laboratory components of those materials.
  - Deepen teachers knowledge and understanding of scientific inquiry.
  - Create a system through which teachers create and share best practices within the CPS.
  - Provide teachers with a formal voice.

- **Curriculum**
  Technology can best be used in the laboratory context in the following ways:
  - Obtain learning outside of physical school environment
  - Integrated into the curriculum, used judiciously and user friendly
  - Balance simulations with hands on practice (Blended approach)

  Curriculum focus is on the fundamentals principles of each science. Focuses of these plans are to:
  - Provide team work and collaboration
  - Inspire and not punish
  - Create an open and communicative environment
  - Position teachers as mentor and facilitator
  - Provide relevant and motivated learning
  - Provide a more manageable, coherent vision for curriculum in science throughout the 100 high school that make up CPS.

- **Management**
  To effectively and efficiently support these activities CPS should prepare to manage and provide the following:
  - Support collaborative learning
  - Provide the learning environment and standard assessment tools for things such as inquiry and investigation
  - Support and promote teacher professional development, following the district's professional development standards.

Conclusion & Recommendation

This session clearly illustrated the need to bring the minimum capabilities of the science programs and laboratories within the Chicago Public School up to the abilities of available technologies, especially if we are going to prepare our next generations to remain relevant in the global marketplace. In order to do this, there is a need to leverage teacher input, obtain available technologies, and incorporate new learning techniques that place a renewed focus on the individual and their ability to collaborate with their peers. In order to achieve these goals, fund raising activities and alternative thoughts such as outsourcing, lab sharing and external labs (museums, etc..) must be considered as the current estimated investment set aside to perform this task is not enough, more time and money must be invested for the future.

Appendix - Detailed Session Notes

<u>Session Objectives</u>

1. ***What Should CPS Students be Learning About Science (What and How)***
    - "Conscious ownership of Authentic Science" – Donald Wink, University of Chicago
        i. questioning and inquisitive nature
        ii. global community and communication impact
    - Consistent theme is that the survival of science needs diversification. Currently, "white priesthood" – Michael Turner, National Science Foundation
    - Today's consumers are looking for increased science and technology skills

2. ***Impact of Labs***
    - There is a need to ensure practicality of plan (begin with the learning objectives)
    - The lab needs to exist in the same space as the classroom so learning events can occur in the moment
    - Labs are more than just the space that is made available in the schools – they can be the entire city (notion of flexible spaces)
    - Experiences and resources must be equal across all schools

3. ***How to Teach Science Effectively***
    - Effective teachers have a variety of effective methods and are flexible within them
    - Create feeling of community and family
    - Acknowledgement of the various learning styles of students
    - Involve and interest students
    - Building the Lab
        i. the teacher's opinion is important (when collecting needs assessment)
        ii. less is more
        iii. diversity of skill sand interests (Respond to WIFIM & relevance to student)
        iv. Challenge of rapid change
        v. technology
4. ***How technology can be used and leveraged in a high school laboratory***
    - Simulated labs (concerns regarding physical capabilities –pipettes)
5. ***Lab Technology Framework***

- Science Text and Lectures
- Management and Interpretation of Data
- Simulations
- Mobility
- Data Collection
- Visualization

6. ***Microsoft – Technology in Education***
    - Process – how it can be applied to learning
    - Majority of computer science graduates being hired are coming from India and China
    - Building the School of the Future (12 month process)
    - "Digital Decade" – improvement
    - Smaller is more relevant for mobility and personal objects – trying to avoid limitations to space and time
    - Assessment – Immediate Learning Moment – Learning Support Tools – Assignment – Follow-up Assessment
7. ***HP – Technology In Education***
    - Collaboration and discussion – video images
    - Anytime – asynchronous
    - Experimentation and Data collection
    - eScience notebook – live conversations with peers, tutors, teachers
    - eBooks for students to take notes and in learning moment and for assessment
    - Applied to all teaching methodologies
8. ***Facilities – Sean Murphy (CPS- Capital Renovations)***
    - Promote collaborations
    - Specialized for different types of learners
    - Living learning laboratory – flexibility issues

Speaker Notes

Michael Turner

- Importance of math, the nature of science.
- Facts always trump ideas
- Science is an international activity that brings people together.
- Mathematics is the language of science
- Computers are used to do experiments that cannot be done in a lab
- Science is an endless frontier and there are many questions in our grasp- many questions will be answered in our lifetime or the lifetime of the children in Chicago public school

Patrick Antony

- The intellectual capital workforce is growing much more rapidly in "developing" world.
- For engineering – no more loners on projects (like Ben Aflack in Paycheck)
- Lifelong learning – (learning how to think?)
- With the technology of the future, computers, engineering, more math will be required then High School math (calculus). Students will need higher math to compete in the world economy.
- We must cultivate young minds to help them get excited in order to cultivate new talent to drive the workforce of the future.
- Desired attributes of an engineer
  - good understanding of science principles,
  - understand process of design and manufacturing
  - good communication
  - starting to work in teams,
  - think critically, creatively, independent and cooperatively,
  - ethical,
  - adaptable to environment.
  - Lifelong learning is very important

Donald Wink

- Students should know content despite some hazards
- Students should be familiar with the process of science. Inquiry isn't just a scientist tool but is a behavior to be modeled by students.
- Science involves premise – why do we do science?
- Science involves reasoning, including mathematic reasoning. How to use algebra, not just to describe but to inquire.
- Fewer labs, but richer, perhaps
- Conscious ownership of authentic science

Norman Lederman

- Presage variables – listing characteristics of good teachers (since 1900)
- Methods of teaching (later early 1900s), inductive vs deductive etc.
  - Process Product- was the most comprehensive research on teaching. Done is the 60s. Discusses what an effective teacher does.

- Competencies- teachers thoughtfully doing something's at some time and some things at another time.
- Professional Decision makers
- Pedagogical Content Knowledge- domains of knowledge and how they are linked in teachers minds.
- Generalizations on effective teachers
  - They provide clarity by using a variety of material and methods
  - Are enthusiastic
  - Task oriented
  - businesslike approach to instruction
  - Avoids harsh criticism.
  - Indirect teaching style- students infer and are not just told
  - Emphasize teaching content that will be on the test
  - Ask questions at several cognitive levels.

- Process-product research (1960s), again studying teachers, how they deal with questions, their affect, etc. then related to student performance. Huge aggregated datasets.
- Competencies – like "effective teachers exhibit clarity" emphasizing when teachers do and should exhibit certain behaviors
- Professional decision-making – extensive use of videotaping and then interrogating teachers about their thought process at key moments
- Pedagogical content knowledge (Shulman) – current rage. Domains of knowledge and interconnectedness. It's become synonymous with "good teaching' which has stymied research
- Modern synthesis emphasizes – meaningful learning, importance of pre-existing knowledge, and active learning. Issues of preconceptions, very resistant to change. **In-depth understanding is based on a strong foundation of factual knowledge.** The biggest problem with inquiry learning esp. in elementary school. Helps to know something to come up with a researchable question.
- Foundation knowledge in a conceptual framework and knowledge organized in a way that facilitates retrieval.
- Less is more – don't try and cover too much, more on overarching concepts
- Not that worried about learning styles, rather helping students adapt to the way the world works.
- Classroom environments – not heavily researched but: learner centered, knowledge centered, assessment centered, community centered.
- Current Perspectives on learning
  - Cognitive Science
    - Meaningful learning- relating what you are learning now to what you already know.
    - Importance of pre-existing knowledge
    - Active learning- Hands on, Minds on
  - Classroom Environments that Foster learning
    - Lerner-Centered
    - Knowledge-Centered
    - Assessment-centered
    - Community-Centered

Louis Gomez

- Science is done by people. Self-concept is significant for learners
- Learning environments should develop who you are, not just what you know
- Why inquiry? Authentic, direct experience, build understanding in context
- Students seeing themselves as budding scientists. They try harder, more sustainable, the work is its own reward.
- Curriculum Development
  - How do laboratories relate to finding out who we are?
  - Curriculum should lead to deep engagement.
  - We need inquiry based curriculum
  - What do you want your students to be able to do?
    - Analyze complex data
    - Question understanding
  - Projective engagement occurs with articulated Participation
  - Projective engagement: when students see themselves in the work
    - Try hard
    - Sustain motivation
    - Recognize success from the work itself
  - Agreement on big ideas and problem setting that will hook students into long-term projective engagement on a concrete set of specific questions in science.
  - We need to provide inquiry opportunities- how can we use this to get more minorities and women interested in science

Daniel Edelson

- Learning for use – a framework for designing learning activities. Help students develop knowledge and skills that they can retrieve and use – useful understanding. Also guides teachers and curriculum developers.
- Motivate, construct from experience, organize knowledge for use.
- How disconnected are practices in schools different from practices in the real world
- "How can we help student develop knowledge and skills that they can retrieve and use once they are outside of the school environment."
- Three stages in Learning-for-use
  - Motivation- based on understanding of usefulness (value for conduction meaningful tasks)
  - Construct knowledge from experience
  - Organize knowledge for use- for accessibility at the appropriate time.

Jim Stankevitz

- Modeling approach features: systematic empirical investigation, student-centric, Forced Concept inventory, ECI, CCI (no biology) amenable to critical evaluation.
- Models capture the similarities that scientists see: equations, problem solving steps, correct numerical answers
- Push that science is coherent, learning occurs through actively seeking understanding.
- In practice: students design own procedures and use peripherals and computers; students have to defend interpretations to peers; models are created and deployed.
- Acceptable solutions account for behavior of the physical system, and are fully explained using multiple representations.

- Extensive use of whiteboards
- It does take a lot of time, they cover less
- http://modeling.la.asu.edu
- Students design their own experimental procedures (uses computers and devices to collect and analyze data).
- Students must justify their interpretations of data to teacher and to the class
- Models created from experiment interpretations must be deployed in careful selected problems in order to "cut the contextual string"
- Solutions are presented on white boards to the entire class (by the students)
    - They defend procedure and results- and are asked questions from the class and teacher. This is similar to how scientists for out in the real world.
- The catch to this approach is that it takes a lot of time. He does not cover all chapters in the book.
- How is it different:
    - Student focused- not teacher focused
    - Students are active not passive
    - Emphasis on cognitive skill versus knowledge transfer.
- Role of instructor
    - Design experiments
    - Must be able to make mistakes
    - Critical listener- must make sure all students are respected.

Anna West

- A very challenging demographic
- Hands on helps get minds on
- Treating everyone the same does not have good results, all students have different teaching styles
- Using only written exams to evaluate the class is not helpful.
- Strategies that work
    - Imaginations are active
    - Active in learning
    - Work better in small groups
- Assessed authentically, not just by written tests
- Active Engagements is a must
- You must connect it to life
- Grouping is important- they begin to work as a team and help each other.

Michael Lach, CPS School Board, Science and Mathematics

- How do those advanced impact the laboratory experience? Technology can solve some of the problems that we are looking to solve.

1. Science text and lectures
    a. Present information in different ways
    b. Putting text books online
    c. Putting science magazines online
2. Data collection and representation- i.e. probes which measures something and then inputs the data into the software.
    a. This is a very inexpensive- makes data into pictures to aid in understanding.
3. Large Data Sets
    a. You can download information for manipulation from the internet
4. Simulations and Models
    a. Inexpensive
5. Discussion and Collaboration
    a. Kids can post questions to experts
    b. Can compare data with Kids all around the world.
6. Mobility
    a. Wireless networks, PDAs low power processing.

Ray Lesniewski

- Starts with observation and inference – bottle of Evian. How do we know it's water? Observations and tests. Fire-water demo. Cyclo-hexane is in flask already.
- Underworld. Werewolves and vampires battling. Liquid silver bullets. Silver nitrate is colorless.

Dennis Liu

- Howard Hughes Medical Institute creates an online system geared to the high school level- website called BioInteractive
- www.DNAI.org

- Website that teachers could use to teach dna- one site is mydna.com. You can set up class specific site from here.
- Modern Biology has become very computational methods now. Biology has become very cross-disciplinary
- Job prospects for students goes way up if they are good at Computers, or math and biology.
- Biology is now working a lot in teams- more for the reasons of productivity.
- A lot of collaboration with competitors.
- Video and real images are still very useful for science teaching
- Science education includes- Facts, concepts, methods, techniques, Ideas, Hypothesis, Theories
- Virtual labs- the real images of science should be in the classroom.
    - Photos and Images,
    - Illustrations,
    - 2D and 3D illustrations.
    - Interactive text
- What good are Vlabs?
    - Sometimes a wet-lab is not always possible,
    - Lots of cheap repetitions, safe
    - model outcomes,
    - Good to prepare for real labs.
    - To reinforce lecture and reading.
    - Very helpful for teachers are not very skilled in that subject matter
- A good way to open a window to cutting edge research… to do an experiment that you would not normally be able to do in a wet lab?

www.Discoverlife.org

Michael Lach/ Ian Robertson

- Working groups: teaching and learning, technology, facilities, funding (be careful of making these groups silos)
- Chicago Math and Science Initiative
- Possible impact of newer technologies – faster/cheaper processors and memory, good graphics, pervasive networking, massive storage, miniaturization, wireless, better software.
- Science texts/lectures – online extends with data, case studies, graphics
- Data collection and representation – lower cost hardware and probes, portability, graphical interfaces.
- Scientific visualization – models and graphical representations, manipulability.
- Large data sets – available from real research, educational opportunities
- Simulations and models – cheap hardware and software available
- Discussion and collaboration – web and computer networks, existing commercially available curricula
- Mobility – small, portable, independent or wireless hardware

Don Wink

- A model for technology inclusion in teaching chemistry
- Chemistry is most invisible, involving molecules that can't be directly seen

- Illinois standards want students to understand these micro level concepts
- Crane HS spectrophotometry in a terrarium
- 3 levels of chemistry – particulate, macroscopic, symbolic
- symbolic example – olivines, beryl/emerald, amphiboles (asbestos), talc/mica related Si elements differing in oxygen valence.
- 3D rotation models to visualize beyond the symbolic level
- www.reciprocalnet.org - crystal structures, also www.geo.arizona.edu/ams/
- A Model for Technology Curriculum
  - Technology in the chemistry classroom- needed because you are trying to explain concepts that are very small- and the ideas have to come alive for the students.
  - One example is of an ecosystem with sensors inside the beaker and they can see the changes over time.
  - Three levels of Chemistry- Macroscopic, Particulate, Symbolic

Mary Cullinane

- Managing the process of building the school of the future
- Philly approached MS with school proposal
- Kids as customers
- 4-6 year olds fastest growing population of computer users
- computer science grads are overwhelmingly Chinese and Indian
- 6i development process – introspection, investigation, inclusion, innovation, implementation, introspection.
- Learning continuum – introduce, renew, validate
- The technology is not going to be the problem- it's mapping to learning goals
- Digital decade – digital mtg, blanket wireless, better pc, reliability, more web, handwriting and speech recog, bernina sewing machine
- Dataset to dataset interaction
- Adaptive learning innovation – individualized triage, pushed assignments
- Environment – always on and aware, Process – good search, people – expert access
- Success factors – leadership, connected community, curriculum proficiency, flexible and sustainable with continuous learning, cross curriculum integration of research and development.
- marycul@microsoft.com
- www.microsoft.com/education/schooloffuture.aspx
- Fastest growing of computer users are 4-6 year old
- Changing CS/IS grads/ US numbers are getting lower and lower.

6i development process is the development.

1. Introspection- Pedagogy, Methodology, Culture success
2. Investigation- best practice, innovation
3. Inclusion- engage community
4. Innovation
5. Implementation
6. Introspection

The digital decade

- Digital management becoming the norm
- Blanket wireless
- A "Better PC"
- Improved reliability and authentication
- Growth of web services
- Improved handwriting and speech technology

3 core factors of examination:

People,

Professional collaboration

Environment

Always on

Integrated data

Process

Collaboration

The school of the future is trying to be a place of best practices that can then be leveraged by educators all over the world.

Jim Vanides

- Likes emphasis on people especially teachers
- The scientific method, not linear, more of a tangled web
- eBinder concept
- Audience really likes notebook idea, ownership, individualized, and ability to reduce sheer bulk of books.
- Wrigley is using tablet computers for research notes now, and Wrigley is a global company.
- Student assessment is vitally important to improving our teachers.
- A MyScience notebook online, they can take notes electronically so they do not have to carry around such a big notebook.
- Collaborate with mentors. Students can write in textbooks and teachers could review their notes and assess their understanding.
- Using technology to help the teacher grade and assess understanding, which then gives the teacher more time to spend WITH the students
- "I know- we Know" approach…. Students teaching students
- Power point can be a very valuable tool… it gives students the tools to teach. It also is a social equalizer, for science fair projects, it gives students who do not have the money to put together a beautiful presentation as well as the kids with money and parents to put it together,
- Notebook could also be used to help integrate curriculums
- What is really going on in the real world?
    - Wrigley is using notebooks in their laboratories. It makes information sharing must easier and easier access to information such as patent information. It also helps with collaboration between scientists in different locations.

Architectural consultant (Rick)

- Client wanted a center for inquiry – Grainger (grant) Center for Imagination and Inquiry. Illinois Math and Science Center in Aurora (residential school).
- Adaptive by subject and student needs
- Wanted visibility – think-tank atmosphere
- Rolling chairs and tables with storage
- Mobile whiteboard – "teaching stations"
- Had to modify existing mobile tables to add durable-resistant tops
- Lockable experiment cabinets for students to leave things up
- Water and fumes hoods are fixed
- Staff facilitator on fulltime
- Multi-functional mobile
- Flexibility is expensive… not always beneficial to be flexible for things like gas and water.
- Had a space to lock up experiments- rental space.
- Mobile chairs, powered tables, mobile white boards

Marty Gartzman

- Chicago math and science initiative c(m+s)i
- Systemwide plan to improve math and science in Chicago – 1st anniversary
- 15 million, 400% increase from previous budgets

- Separate capital budget
- Chicago is 3rd largest district with 600 schools 900 building, 40,000 employees and 440,000 students. Local decision process.
- 1000 math teachers, and 1000 science teachers. 589 biology sections.
- 8th graders are entering better prepared than in the past. ISAT data, also PSAE (prairie state exam)
- algebra and then science (25%) highest failure rates
- NCLB guidelines 88% teachers in math were major or endorsement qualified
- Coherence problem even within a school
- Once you're off track in math and science, you're very unlikely to get back on.
- Math requirement isn't just failing them for science and math, but out of school completely
- Attempts to make administrative posisitions more directly supportive of teaching
- Need to remember that there are other physical limitations like leaky pipes and bad roofs, there are too many demands for the money available.
- 602 schools, 27,000 teachers
- Science has highest failure rates, behind only algebra. About ¼ of the students fail.
- No Child left behind act drives which teachers teach which subjects
- Improvements are planned to be made through the Math Science Initiative
- CMSI high school cornerstones
  - Target At risk students
  - Strengthen professional environment
- 40% of students in inner cities are failing algebra, once they get behind in math they have trouble graduating. So in essence, the math department is not only pushing them out of a math and science career, but out of graduation.
- Initiative to standardize/get coherence on testing, curriculum, and use collaboration across all teachers/

http://cmsi.cps.k12.il.us

Robert Runcie

- $4.8 billion enterprise, spent $58 million locally IT, $50 million on IT infrastructure. Federal program provides $50 million (phone bills etc.)
- Each school has a T1 to central network, want to order 2nd T1 to high schools, Chicagoland initiative to develop wide bandwidth metro ring.
- 4500 wireless access points
- 70,000 workstations and laptops (10,000 are administrative)
- WAN is segregated into admin (business apps, student records) and educational
- Contract to purchase and service computers
- 40 year old academic management system
- New system hopes to include instructional elements with record management
- Execution – start with a cluster of schools to prove concept and then broaden rollout. It's also cost effective.
- In Chicago only 15% of capital budget comes from state, 48th. In Philly 70% come from State.
- Looking into broadband to student homes, and also to share more student information with parents (Chicago less than 50% internet access?)

- Recycle about 10,000 CPUs a year
- 300 independent library systems in schools
- 4.8 billion dollars, 150 million spent on technology last year.
- All schools have a T1 lines, they want to take a second T1 into each high school.
- About 70,000 laptop and desktops, 10% are administrations.
- They do not have good technical support,
- Aerospace initiatives, web conferencing.
- CPS teachers can be online- facilitator
- Educational goal is Improving Literacy

Sharnell Jackson

- eLearning initiatives – almost completely grant funded
- Videoconferencing, COSA, CPS-VHS, Lesson study, web conf., aerospace init, cable programming (only 28 schools lack), media dist., pda, software
- 208 students in 32 virtual high schools in 2003, by 2004 42 high schools with about 1178 students courses, AP review, and ACT prep. 75 teacher facilitators
- Simple things like report attendance online helpful

Sean Murphy

- Provide every HS with a prototype science lab
- Limited renovations of existing labs
- Prototypes are $500,000 each and add lab capacity to each school
- Renovations are about $200,000 each, typical school has 4-6 labs
- 71 prototypes, and 150 renovations so far in Chicago high schools
- Next 5 years, budget of $25mill, operating deficit largely bond funded and tax increment financed
- Average age of school building is 65 years.
- >2500 students? Then you get a prototype lab
- Priorities: stabilize exteriors, then mechanical systems, lastly interior renovations.
- Only about ½ of kids actually get into a lab
- Wants $95 million to renovate HS science labs
- Then wants to move on to elementary schools
- How about shops? Also need renovation.
- 50% of CPS students that enter HS don't graduate
- Goal is to provide CPS high school students with the opportunity to learn a variety of science curriculum.
- Prototype science lab
    - Added room
    - Cost 500,000
    - Gas, water
    - Safety, shower, eye wash.
- Renovate old labs: 200K each (4-6 per school)

Next Steps (as they are set today):

- 25M budget
- **B**uild prototype lab at the two schools that have not received them yet.

- Add additional prototype lab with enrollment over 2,500
- First priority is keeping kids warm and dry.

Program needs:

- Needs more than 95M to renovate high school science labs
- A systematic approach and funding source to renovate elementary school science classrooms.

General discussion

- Look for models. There must be other large school districts that have wrestled with these issues.
- Economic assessment of costs of losing students. $83,000 to keep a kid in juvenile detention.
- Physical vs virtual, hands-on vs minds on. Content in context. Unlearning bad habits in teaching etc.
- True performance and understanding vs. test performance
- Training is critical and don't forget to tap teachers that are ready to go
- How does science relate to students who won't be going on in science/engineering related jobs?
- Biggest problem is discontinuity; get away from learning "a science."
- Harnessing pervasiveness of and interest in everyday technology
- Role of mentorship
- Microsoft school of the future – pervasive thinking about classroom, lab, lunchroom etc. Increase relevance, use student interest in people.
- 3 years of science required to graduate Chicago HS (100 schools)
- Wheaton school district redid science curriculum by diffusion model
- Companies require strong employees. In all areas- you need to understand science, even for employment in places like banks.
- Many companies do not hire "trainees" any more- they want the students to be coming out of colleges with the skills they need.
- What Key principles do we need our high school students to be coming out of high school with.
- What is wrong today in HS today with science education?
    - Discontinuity- how is physics important to chemistry. Students should know they are in multiple years of science education- like a language. When taking Biology, it is not to us complete Biology- but they will be using it for all science educations.
    - It is more then teaching science- implanting excitement of math and science.
    - Once they decide that they are not good at math, how can we break this thinking
    - Inspiring people must be an influence
    - Learning to work with a mentor- to foster learning, everything from learning the ropes to solving the problems.
- What is uninspiring about the labs today?
    - They need a learning environment that is more
        - adaptive,
        - collaborative,
        - relevance,
        - Put a face on science, how can we use mediums of today to bring it to life for the students.

- We have relied on immigration to subsidies our scientific work force. But immigration is dropping. Part of what is missing is the science background in the primary schools. You cannot complain about outsourcing if you are not providing the resources in the US.
- 40% of Microsoft employees have Visa's. 80% of Boeing employees have bachelors degrees and the rest have associated degrees.
- If equipment at home (video games) is better than equipment at the lab, we will never gain the students attention.
- There is some research that community build by members form multiple years… say for example, using a student 1 year earlier to come and teach the group how to use the technology is very effective.
- What are the objectives for the Chicago public schools?
- Can we use technology to get to the learning objective… instead of getting lost in the technology. So the students do not get bogged down in just trying to use the technology and loose track of what they are trying to learn
- There are 100 high schools in the Chicago public school system. Three years of Science is required for graduation (physics is an elective). Some classrooms are very simple and some are technologically advanced.
- What about thinking about the school as the laboratory. Labs need to be more then the physical space that the students sit in. Redefine the term laboratory to include all of Chicago.
  - Problems with this is that laboratory is a controlled environment- where experiments are hard out in the field because there are so many other piece. Plus factors such as cost, safety, travel etcetera, are limiting factor.
- How important is space?
  - lots of the schools to not even have a reasonable space.
  - For example, new development at Wrigley was to have a space that was collaborative, flexibility in space and function.
  - We want to make sure that a new age lab today will still be relevant in 2020.
- Want the classroom to be the lab. I don't want a lab at the end of the hall.
  - And should all classrooms look the same? Chemistry look different then physical science?
  - I don't need a fume hood, or even water and gas in my room- they just take up space that I could be using for my students to move around and do an experiment. – Matt, physics teacher.
- It is VERY important to find out what the teachers need.
- But how important is it to have space that is flexible? When demand changes how can the space change.
- What needs to be in a lab??
  - the teacher is critical.
  - less is more sometimes.- students will get lost in actually figure out what you are doing if there is TOO much complex equipment
  - The space needs to compliment the diversity of skills and interests of the students, builders, thinkers, explorers- we need to be able to give each one of them an outlet to gain confidence in their specific skill area.
  - Teamwork is an important part of modern science.
  - Flexibility- the challenge of rapid change.
- 70 million is a hope to be raised

- There are about 100 high schools with about 6 labs a piece in the Chicago School district
- What about each high school doing a proposal, maybe in districts
- Our goal is to provide the best education to all Chicago school children.
- Prototype labs have already been done- we need to focus on providing a science education to all Chicago students.
- Are the tools of evaluating student skills going to replace the teacher?
    - Answer: It should be more of a teacher tool. These technologies are nothing without a good teacher.
    - Answer: The investment in technology needs to be balanced with professional leadership and making sure that the teachers can work with the technology and use it as a tool. This will be even harder in the underprivileged areas… it is very important to foster human capital.
- How can CMIS tap into any initiatives that have already been done around the country in other large cities?
- Goal is to complete the renovations in 5 Years
- There is a continuum that says that where are you going to spend limited money?
    - Physical vs. virtual- can we do some things virtually, or what is really important to keep in a physical content
    - Hands On vs. Minds On
    - Context and content- what does it mean and what are the implications
    - Unlearning- how do we change the way students view their ability within science
- Science labs should improve test scores because it teaches children how to be analytical
- Use the teachers that really want to use the facilities first, whose hearts are in the need for good facilities because they will make use of it.
- You cannot get lost in needing to cover every piece of the textbook, make sure the students have a deep understanding of the fundamentals and build analytical skills.