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ABSTRACT

The National School-to-Work Office in collaboration with the National Association for Gifted Children, the Council for Exceptional Children, the Association for the Gifted, and the Council of State Directors of Programs for the Gifted have identified 11 gifted education/school-to-work (GT/STW) models that are either best practices or unique approaches. This information packet provides an overview of one of the unique approaches models: the Regional Electronic Magnet School Re: Math and Science (REMS2) in Massachusetts. This project demonstrated, evaluated, and disseminated a pilot electronic magnet school for talented math and science students at 15 Massachusetts high schools. Its aim was to expose students to real-world research problems and methods. High school math and science teachers collaborated with corporate and university scientists, who served as student advisors. Teachers gained professional development and students learned experimental design, laboratory skills, instrumentation, mathematical modeling and problem solving, and exploratory data analysis. Participating students received high school credit and were brought together for a two-week Summer Institute at the University of Massachusetts-Lowell with professors, corporate engineers, and scientists in biology, chemistry, computer science, engineering, environmental science, health sciences, and mathematics, where they developed research projects. The information packet includes a program overview, a videotape, and relevant articles. (CR)

Gifted Education/School-to-Work Models: Best Practices and Unique Approaches. Regional Electronic Magnet School (Massachusetts): South Coast Educational Collaborative.

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Gifted Education/School-to-Work Models: Best Practices and Unique Approaches

The National School-to-Work Office has been collaborating with the National Association for Gifted Children, The Council for Exceptional Children, The Association for the Gifted, and the Council of State Directors of Programs for the Gifted on a national effort to identify exemplary Gifted Education/School-to-Work (STW) models. Our purpose has been to forge new relationships between the STW and gifted education communities around common and critical goals: teaching rigorous and relevant academic skills, identifying and developing talent, and guiding career development. We believe sharing these practices will expand learning opportunities for all learners by building an even richer and more inclusive STW system, and by "raising the bar" on learning and teaching for all students.

We use the term "gifted and talented," which is broader than "academically talented" (used in the School-to-Work Opportunities Act), because state definitions of giftedness mostly use some variation of the current federal definition, which is (1988 Jacob K. Javits Gifted and Talented Students Education Act):

> *Children and youth who give evidence of high performance capability in areas such as intellectual, creative, artistic or leadership capacity, or in specific academic fields, and who require services or activities not ordinarily provided by the school in order to fully develop such capabilities.*

Last year, letters were sent to state-level STW and gifted education directors and association leaders to help identify gifted education models that also exemplify STW. Submissions were also requested on all gifted education Listservs. We received 23 competitive submissions.

A technical review process was used to ensure that all submissions were thoroughly and impartially evaluated. An outside review panel was assembled which comprised experts in gifted education and STW. Their experience included state gifted education and STW leadership, local STW program evaluation, and post-secondary gifted education research. All submissions were evaluated according to criteria consistent with guidelines made available to all applicants.

Five **Best Practices** and six **Unique Approaches** were selected by the panel. The designation "Best Gifted Education/STW Practice" signifies excellent progress in implementing a comprehensive STW system that challenges high achieving/gifted and talented students. The designation "Unique Gifted Education/STW Approach" recognizes a unique program element. Unique Approaches did not present all key components of a comprehensive STW system (school-based, work-based, and connecting activities), or provide sufficient information about how gifted and talented students are served.

Programs evaluated as very strong:

- specifically serve gifted and talented students;

• demonstrate a school-based learning component that supports and builds on a work-based learning component, and provide students with high level academic and technical skills and opportunities for career exploration and guidance;

• demonstrate a work-based learning component connected to academic classroom learning, and prepare students for the diverse skills needed in today's high-performance workplaces;

• present connecting activities that build and maintain linkages between students, educators, the workplace, parents, and others in the community;

• provide evidence about effectiveness, including indicators that it could be replicated in diverse settings throughout the country; and

• address identified priorities such as strategies to: improve math and science achievement, serve gifted students in rural and urban areas, enhance middle school achievement, and promote linkages with institutions of higher learning.

A brief description of one of the 6 **Unique Approaches** follows:

REGIONAL ELECTRONIC MAGNET SCHOOL (MASSACHUSETTS): *Unique Approach: "Virtual" magnet school.* The Regional Electronic Magnet School Re: Math and Science ($REMS^2$) was a research project conducted under the U. S. Department of Education's Jacob K. Javits Gifted and Talented Education Program that demonstrated, evaluated, and disseminated a pilot electronic magnet school for talented math and science students at 15 Massachusetts high schools. Its aim was to expose students to real-world research problems and methods. Master high school math and science teachers collaborated with corporate and university scientists, who served as student advisors. Teachers gained professional development, and students learned experimental design, laboratory skills, instrumentation, mathematical modeling and problem solving, and exploratory data analysis. Students received high school credit. Students were also brought together for a two-week Summer Institute at the University of Massachusetts–Lowell with professors, corporate engineers, and scientists in biology, chemistry, computer science, engineering, environmental science, health sciences, and mathematics, where they developed research projects.

CONTACT INFORMATION

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May 12, 1998

VIA OVERNIGHT MAIL

Lorraine E. Kleinwaks
Gifted and Talented Students/Parent Involvement
400 Virginia Avenue, S.W.
Suite 210
Washington, DC 20024

Dear Lorraine,

It was a pleasure speaking with you regarding education initiatives to link gifted and talented students with school-to-work. REMS (Regional Electronic Magnet School) which was a 3 ½ year research and development project sponsored through a Jacob K. Javits Grant. The REMS model became exemplary. I think you will find that it incorporates all of the criteria for your program submission. I am pleased to offer it for your review and consideration.

Sincerely,

Burt

Burton E. Goodrich, Ed.D.
Executive Director

BEG/jw

Enclosures

Title of Program: (REM)^2 Regional Electronic Magnet School Re: Math and Science

Date of Program: Fall 1992 through June 1996

Contact: Dr. Burton E. Goodrich
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South Coast Educational Collaborative
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(1) **Type of Program:**

Academic enrichment for rising juniors. Approximately 90 students from 15 different high schools participated annually.

(REMS)^2 expanded background and interest in Math, Science, and Technology through a stimulating **two-week Summer Institute and Junior year learning and research experience.** It provided enrichment opportunities that extended the regular school experience. The program's aim was to lead and challenge gifted students through exposure to current research problems and methods and connections to "real world" experiences.

(2) **Talent Development:**

A weekday **"Summer Institute"** was conducted in July on the campus of UMASS @ Lowell and various corporate research sites.

A **"Junior Year"** program was conducted from September to June. Students participated in a variety of enrichment activities including after school and weekends, and students conducted research in areas of their own.

Topics of common interest, including general areas in Math, Science, and Technology were studied and explored. Students identified particular areas of interest, and conducted research in those areas. Corporate and university researchers and scientists served as advisors to support, guide, and assist students. Students participated in projects that encouraged problem solving, logical thinking and incorporated strategies that were challenging and were pursued individually and/or with their peers from surrounding districts. Students learned experimental design, laboratory skills, instrumentation, mathematical modeling, strategies for mathematical problem solving, and exploratory data analysis.

(REMS)^2 was open to qualified secondary school students who were entering their junior year of high school. Applicants must have demonstrated superior academic ability and interest in math and science. Individualized attention was provided by the program. Selection was competitive. A nomination from a high school mathematics or science teacher was essential.

A faculty of master high school teachers, selected in areas of science and mathematics, worked in cooperation with professionals from college/university and industry in guiding students through academics programs especially designed to provide experience in scientific and mathematical problem solving. The principal instructors in the Summer Institute were experienced teachers, professors, scientists and researchers. Advisors for Junior Year exploration and research were corporate and university researchers and scientists who supported, guided, and assisted students with their personal study and research interests.

(3,4) **Partnerships and Connecting Activities:**

Partnerships were established with area corporations. These partnerships provided on-site, hands-on experience for the students and teachers during the Summer Institute. Additionally, corporate scientists and engineers served as mentors to students to assist them to design and carry out research projects (see appendix for sample of student research projects).

A strong partnership was established with the engineering, science, math, and technology departments of University of Massachusetts, Lowell. Professors taught hands-on exploratory programs during the Summer Institute (see appendix for sample studies). Professors served as mentors to advise students with research projects.

Students, teachers, university professors and corporate scientists and engineers were linked via e-mail. This facilitated on-going communication and the development of a "virtual learning community."

(5) **Integrated Curriculum:**

During the Summer Institute, students developed real-world research projects. Formal instruction was provided to students and teachers to facilitate "Planning, Conducting, and Documenting Research Projects." Their projects were carried out during their junior year in high school. Many of the research project extended regular studies in math, biology, chemistry and technology.

All schools provided support to students and teacher for (REMS)^2. All gave credit and recognition on the transcript. Some schools build the (REMS)^2 program into the regular curriculum to give students and teachers time to persue this work. Teacher planning time to accommodate new responsibilities and learning experience was extensive.

The following examples demonstrate the level of follow through and learning:

One girl worked with a biology professor at Tufts University throughout the school year. She participated in actual research being conducted by the professor. She and her professor co-authored a journal article on their research.

One boy's family owned and operated a large vegetable truck farm and stand. He was interested in hydroponics (growing crops in nutrient rich water). Over two years he developed a viable model that eventually expanded to fill a greenhouse. He won first prize in the Massachusetts State Science Fair conducted at Massachusetts Institute of Technology. He applied to Columbia University, because of its expert studies in hydroponics and was recruited via e-mail by professors. He is currently a senior at Columbia University majoring in this field.

(6) **Classroom Support:**

$(REMS)^2$ provided extensive professional development for the 30+ participating teachers. Initially, they meet monthly to design the program and to acquire new skills (e.g. e-mail; assisting students to develop research projects; forming corporate partnerships). During the Summer Institute, teachers and students both participated in all learning experiences. During the school year professional development was provided by expert consultants who worked with us throughout the 3 ½ years. Professional development included the three key elements of awareness, training, and support. Graduate credit was also provided for those staff desiring that option. Educating gifted and talented students was studied extensively. This theory was translated into diverse learning styles and needs as represented by hands-on, exploratory learning during the Summer Institute, research projects, electronic communication, and mentoring.

(7) **Parent Involvement:**

Parent involvement was extensive. It began with the application process wherein parents assisted their child to apply. Open houses to present the program and to address parent and student questions were conducted. After the program had been underway for a year, participating students presented their projects to perspective students and parents. Teachers, professors, corporate mentors all participated. Parent testimony in support of $(REMS)^2$ was extensive (see appendix for sample parent letter).

(8) **Innovative Approaches:**

$(REMS)^2$ was innovative in most ways. When we started we only had the concept of a regional electronic magnet school. By working together for six months, teachers, program staff, and partners "constructed" this new learning environment. Each year, the model was refined and extended.

$(REMS)^2$ was unique in many ways:

- Students remained in their own high school
- Approximately 90 students from 15 different schools across the Merrimack Valley of Massachusetts participated
- The program included a two week Summer Institute on the campus of UMASS @ Lowell
- Students participated during their Junior Year
- Students had enrichment and research opportunities with corporate advisors and college faculty that extended beyond their regular school program

$(REMS)^2$ was a "virtual school" made possible by an electronic computer network connecting all students, teachers, college and corporate advisors. This electronic computer network connected to the world! $(REMS)^2$ was on the "cutting edge" of the information age school.

All schools gave credit for the program. Some schools built it into the regular curriculum. Some of the schools extended what they learned from $(REMS)^2$ into other aspects of the school and curriculum for additional students. In these cases, $(REMS)^2$ served as a catalyst for new instructional modalities.

(9) **Career and Academic Planning:**

Career and academic planning was an important component. Pupils elected corporate visits, research projects, and mentor support based upon their own areas of interest. Visits to corporate sites exposed pupils to the real world situations. Mentors talked about their careers and demonstrated their actual work.

Professors exposed pupils to academic areas that challenged and stretched their interests (e.g. electron microscope, nuclear reactors, spread of contagious diseases, solar power).

(10) **Supporting Materials:**

Extensive documentation and evaluation was conducted for all components of $(REMS)^2$. Data was gathered and tracked over the 3 ½ years. Findings informed the program and adjustments were continually made to enhance and extend the program.

Most significantly, we conducted a retrospective analysis of $(REMS)^2$ after 3 ½ years. That retrospective is enclosed and can serve as a basis for those wishing to replicate this model program.

Linking gifted and talented students with School -To-Work should be a natural process; a process that holds great potential to "reinvent school and schooling."

$(REMS)^2$: A RETROSPECTIVE

What have MEC and its partners accomplished after more three years of work on the $(REMS)^2$ project? What has worked well? Where are the shortfalls? What have we learned and what implications does that learning have for the way we continue to pursue similar goals and objectives in other programs and services?

These questions prompted this retrospective assessment of $(REMS)^2$. To address them, I reviewed all previous evaluation reports and much of the documentation that supported them. I particularly focused on the conclusions and recommendations in those reports. I also examined other MEC programs and services, both those that were in operation during all or part of the $(REMS)^2$ project period and those that have developed since $(REMS)^2$ closed down formally.* In addition, I interviewed key MEC staff and obtained the perceptions of $(REMS)^2$ project participants from the participating high schools.

I have organized the retrospective around the key components of the $(REMS)^2$ project. I discuss each component and provide examples of how the learning from work on that component has impacted other MEC programs and services.

PROBLEM-BASED LEARNING (PBL)

$(REMS)^2$ emphasized the use of student-identified problems as the focus of their projects that required applying knowledge and skills from the disciplines of math and science. This emphasis was a natural consequence of working with teachers from fourteen high schools and scores of students over the three years. It was impossible to develop a common content focus, nor was one desired. The action research process was common, however, with a focus on real-world problems in the workplace and the community. MEC staff and the participating teachers facilitated the use of a structured problem-solving, action research process.

While a few students each year struggled with identifying a topic, most found this a motivating and satisfying way to pursue their learning. Teachers were nearly unanimous in their enthusiasm for this approach. The project took on some aspects of a science fair, at least in its demonstration/exhibition phase each spring.

One consequence of pursuing a problem-based learning (PBL) approach was that it did not require alterations in the existing curriculums in the participating schools. Indeed, because the project operated outside of the regular curriculum, it did not need to impact the curriculum. There was no firm evidence that $(REMS)^2$ influenced any substantial curriculum revision, although this is difficult to determine because so many other forces were at work — national standards, state frameworks, PALMS, and other incentives to upgrade curriculum.

* The project officially ended on March 31, 1996.

With rare exceptions, the teachers participating in the project reported that the (REMS)² approach influenced the way in which they conducted their regular courses in science and math. Most reported bringing some aspects of the problem-solving approach into the learning opportunities they provided. With few exceptions, however, the participating teachers reported that the (REMS)² approach has little or no impact on the nature of learning opportunities in the high school. That is, many aspects of the project, including PBL, were not adopted.

Although MEC devoted considerable attention to institutionalization during the second and third years of the project, there is little evidence that the high school faculties gave serious consideration to a large-scale movement to problem-based learning as a result of (REMS)². The power of the high school culture proved impermeable to the efforts of two teachers who did a large part of the project work outside of the regular school program. In some cases, participating teachers did not see themselves as empowered to serve as change agents for the project.

The project's influence on MEC, however, was quite substantial. During the last year MEC has revamped nearly every one of its professional development offerings to incorporate some aspect of problem-based learning. MEC has also used its role as a regional service provider in the state PALMS project to further the incorporation of problem-based learning as a central component of the districts' plans for systemic reform of math, science, and technology.

Finally, PBL has been incorporated as a key design principle in the high school restructuring network which MEC is facilitating. The network of fifteen area high schools is in its second year of operation and has focused during year two on curriculum and instruction design. Moreover, several high schools are moving toward some form of block scheduling, where larger blocks of time would more easily accommodate problem- and project-based learning. Moreover, the increased use of technology, particularly telecommunications to support learning, has prompted a shift from information dissemination to knowledge creation to serve action and application.

TECHNOLOGY APPLICATIONS

MEC has been a leader in the region and in the state in the use of telecommunications and other technology applications to support teaching and learning and organizational effectiveness and productivity. It brought this experience to the (REMS)² project and developed new insights into its use in support of PBL and other improvements in teaching and learning and in organizational effectiveness and efficiency.

Perhaps the most significant technology application was the use of telecommunications and the Internet. Indeed, (REMS)² actually grew up with the Internet. In the first year of the project, telecommunications were accomplished primarily through MEC's own e-mail system. The Internet was not a dominant resource, primarily because the World Wide Web was just forming and software tools for accessing the Web were not user friendly.

Powerful tools for searching the Web became widely available during the second year of the project, and MEC brought them into widespread use in the project.

The Web was a powerful resource in the PBL approach and the participating students accepted it with enthusiasm. Based on its experience with the Internet during the (REMS)² project, MEC has incorporated its use into nearly every aspect of its professional development services and programs. Given the range of resources available on the Web, MEC is able to identify a handful of appropriate Web sites for nearly every workshop it conducts. In addition to stand-alone workshops on the Internet, MEC has chosen to focus on incorporating its use into all other workshops, modeling the practices it wishes its teachers and administrators to adopt.

LEARNING ENVIRONMENTS

(REMS)² students did their learning in many places outside of schools - community, higher education, businesses, ponds and streams, in cyberspace. (REMS)² accelerated a developing trend toward moving students into the community and the work place for their learning. The summer institute was major stimulus in that direction in that it introduced other elements in addition to learning in a specific place or setting. Time was another variable that was addressed in a very different way by the (REMS)² project. The increased use of electronic telecommunications and research allowed for an increase in asynchronous learning. Students worked at home on their projects, in effect increasing learning time. (REMS)² demonstrated the power of out of classroom learning as an essential component of every student's learning program. Some project teams used the telecommunications system to conduct their collaborative work, including linking to higher education and workplace mentors and advisors.

SCHOOL RESTRUCTURING

Although some of the high schools participating in the project are coincidentally looking at different uses of time, including semestering and block scheduling, the connection of that work to the (REMS)² project was serendipitous at best and often times not included. This is unfortunate since (REMS)², if adapted, could help teachers use the new expanded instructional time more productively and efficiently.

(REMS)² promoted communication and collaboration among schools, teachers, and students. The racing car project initiated during the institute served as a major example of how diverse teams of students and teachers would come together to collaborate on a common project.

There were other forces for restructuring. School-site teams are in place to guide overall schoolwide improvements. (REMS)² became another option for schools to offer to selected students. With all of the attention to alternative schools, each school must itself offer alternatives to its students. With the development of curriculum standards, it is possible for schools, and schools within schools, to vary the learning opportunities and learning environments they provide while addressing challenging and motivating standards for all students. The state curriculum frameworks allow schools to try new approaches while focusing on a common set of results.

SHARED DECISION MAKING

The power relationships between teachers and students were impacted by the (REMS)² project, since the teachers in a problem-solving mode needed to serve more as facilitators and guides than as traditional instructors. MEC employed a shared decision making approach to (REMS)² design and implementation. Participating teachers were involved in nearly every aspect of planning and implementation. Students chose their projects and designed their own workplans with guidance from their teachers, advisors, and mentors. In some cases, students served as teachers of other students and of their teachers.

PARTNERSHIPS

MEC's success with partnerships has been mixed. The working relationships with higher education have been the most promising. After a difficult first year, MEC instituted special planning sessions with the higher education faculty and supported joint planning between the high school and higher education faculty. These sessions proved to be a catalyst for productive partnering in the design of the summer institute and in the mentoring relationships occurring throughout the school year.

The partnerships with area businesses were less successful. Students reported that the visits to the corporate sites during the institute were of limited utility. In most cases, students found it difficult to establish productive mentoring relationships with corporate staff. The less than optimal results in this area may be attributable to the different cultures of the business and education communities. The time commitment to mentoring is substantial and the results are not always immediately apparent. Nevertheless, this component is important as a means of providing school-to-work experiences for high performing college-bound students.

SYSTEMIC CHANGE

(REMS)² has had a substantial and continuing impact on the region's high schools in particular and it elementary and middle schools as well. The Summer 1996 middle school institute will bring the best of (REMS)² to the middle school level and incorporate some of the systemic redesign approaches being used in the PALMS and High School Restructuring programs.

Perhaps the most substantial and lasting impact of (REMS)² will be realized through MEC's ongoing professional development and school improvement programs and services. Over time, hundreds of teachers and administrators from the two dozen districts in the region will be influenced by their participation in MEC programs.

MEC, through (REMS)^2 and other programs, has provoked high schools to examine a number of innovations which challenge their "DNA". They are experimenting with new time structures and interdisciplinary learning.

(REMS)^2 made a limited contribution to the schools' work on systemic change. The project was not very successful in attracting top level administrators to see the potential of (REMS)^2 as a model for fundamentally reformed pedagogy and the implications of that reformed pedagogy for the organization of schools and schooling.

(REMS)^2 was treated pretty much as a project for a specific group of students. Many high school teachers, even some of the (REMS)^2 teachers, were skeptical of a reliance without a complete transformation to a problem-solving approach. Many teachers expressed concern with covering content which is paramount, and they had difficulty forming an image of how that content could be addressed other than by traditional teaching methods and classroom organization. Content mastery, not applications, are valued. In general there was no fundamental change in any of the schools' core pedagogy and organizational structure.

NEXT STEPS

Based on this retrospective review of our learning, there are several areas for future growth and development.

1. **Extend and refine the education, training, and support system.** MEC should continue to refine and expand its use of the education, training, and support cycle in designing and implementing staff development services.

2. **Extend and refine the telecommunications infrastructure** and enhance that work with a reliance of some form of groupware. For example, MEC might reach into homes to provide learning opportunities to parents and students. MEC might establish a virtual school, with students working alone or in teams on projects of interest.

3. **Extend PBL into all aspects of MEC's curriculum and staff development work.** With increasing attention to block scheduling, integrated curriculum and instruction, and authentic assessment, MEC could become a regional source of technical assistance and staff development on the design and implementation of PBL opportunities and environments. This work could also be linked to the state curriculum frameworks.

4. **Enhance work on partnerships**, perhaps by adopting some of the learning from the PALMS project. PBL requires linkages to the workplace, whether it be a business or a community setting. The PALMS project is developing approaches to better connecting parents, businesses, and community resources to schools. MEC should consider applying the learning from PALMS to future applications of PBL.

A RUBRIC FOR ASSESSING
HIGH CHALLENGE
LEARNING ENVIRONMENTS AND OPPORTUNITIES

Suggested Criteria for High Challenge Learning Experiences	Observations and Comments about the degree to which the Desired Characteristic is Present in the Learning Experience	Rating: 5 . Always 4 = Most of the time 3 = Some of the time 2 = Occassionally 1 = Never
1. To what degree is the student involved in tasks that are broad in scope (not divided into fragmented tasks), and provide a challenge (intellectually demanding and not easily accomplished)?		
2. To what degree does the student have control over the work process (not directed by a dominating hierarchical authority)? Is the teacher or instructional delivery system a "coach" or resource, not a "supervisor"?		
3. To what degree is the student given opportunity to work collaboratively and cooperatively?		
4. To what degree is the student given opportunity to practice or apply communication skills during the learning task?		
5. To what degree do the learning tasks, in format and in goal, vary from one another?		

A RUBRIC FOR ASSESSING . . . (continued)

Suggested Criteria for Selecting or Creating Inquiry-based Learning Experiences	Observations and Comments about the degree to which the Desired Characteristic is Present in the Learning Experience	Rating: 5 = Always 4 = Most of the time 3 = Some of the time 2 = Occassionally 1 = Never
6. To what degree is the student encouraged to try different ways of coping with or addressing the learning task?		
7. To what degree does the learning task explicitly teach problem solving and higher-order thinking skills or provide opportunity for the student to apply and reflect on these skills?		
8. To what degree is there variety in what is considered an acceptable approach, product, or solution to the learning task (responses are not standardized)?		
9. To what degree are the student's personal ideas and contribution to the task or product encouraged and valued?		
10. To what degree does the learning task intrinsically motivcate the student (i.e., accomplishing the task is a reqard unto itself and not seen primarily as a way to obtain a "material" or "other-bestowed" reward?		
	Total:	

Creating a "Virtual" Magnet School

by DR. BURTON E. GOODRICH, Associate Director
Merrimack Education Center
Chelmsford, Mass.

A group of educators in the Merrimack Valley of north central Massachusetts is creating a "virtual" magnet school. Called (REMS)^2, an acronym for Regional Electronic Magnet School - Re: Math and Science, the project leads and challenges students through exposure to current research problems and methods. (REMS)^2 combines two complimentary but rarely connected strategies—the focused attention of a magnet school model for talented high school students plus a powerful electronic network and resource system.

(REMS)^2 is an educational research project being conducted under a grant from the U.S. Department of Education's Jacob K. Javits Gifted and Talented Education Program. This three-year project is designed to demonstrate, evaluate and disseminate a pilot electronic magnet school model in serving selected high schools throughout Massachusetts. The model effectively utilizes an electronic network to integrate and communicate beyond existing classroom and school boundaries. Further, the project demonstrates that partnerships with university faculty and corporate scientists can effectively support authentic, complex research and the development and application of higher-order learning skills.

Broad Reach: University and Corporate Roles

(REMS)^2 encompasses 14 comprehensive and vocational high schools and draws on teaching and research faculties from the University of Massachusetts at Lowell and Fitchburg State College in the fields of mathematics, science, engineering and technology. Faculty members serve as instructors and guide students' individual and group projects. The project fosters active partnerships with area corporations that provide connections to real research and development. Corporate advisors also help guide students' research projects.

(REMS)^2 expands background and interest in math, science, engineering and technology through a stimulating two-week Summer Institute and Junior Year learning and research experiences. The project provides enrichment opportunities that extend beyond regular school experiences and school walls to a regional, and even a global, classroom.

Example Activity

Mike Phillips, Michelle Oullette, Karen Noyes and April White, four students from three different high schools, have formed a "programming team" that is leading an effort to prepare a multimedia presentation about (REMS)^2. During the Summer Institute, Mike proposed this project idea to fellow students and secured the assistance of several others. Any student is welcome to contribute to this project according to their personal area of interest such as writing, photography, programming or production. As project managers with defined areas of responsibility, Mike, Michelle, Karen and April coordinate the total project effort through telecommunications and face-to-face meetings.

The programming team is using sophisticated authoring software to develop their multimedia presentation. Dr. Jesse Heines, a professor from the University of Massachusetts-Lowell, exposed them to the software during the Summer Institute. Heines serves as advisor to this team and provides on-going support. For sharing their research and development project with community and school groups, the project team has identified several possibilities including a satellite broadcast to other schools in the state via the Massachusetts Corporation for Educational Telecommunications (MCET).

"Virtual" Magnet School

Most magnet schools are brick and mortar structures, either day or residential. To participate in such magnet schools, students must usually break relationships and ties with their regular high school peers, programs, curriculum and activities. At the same time, the regular high schools are drained of their academic

This three-year project is designed to demonstrate, evaluate and disseminate a pilot electronic magnet school model.

and leadership skills. This represents a double loss for both student and sending school.

(REMS)^2 is different. It is a "virtual" magnet school. While students and teachers do come together for a two-week Summer Institute and selected Junior Year school year activities, the "brick and mortar" that holds (REMS)^2 together is the leadership and linking management provided by the Merrimack Education Center and a powerful telecommunications highway.

Students participate in (REMS)^2 as an extension of, not a replacement for, their regular high school experience. Through all (REMS)^2 activities, students are guided and supported by master science, technology and mathematics teachers from their own schools.

(REMS)^2 is unique in many ways:

- Its population—56 students and 27 seven master teachers from 14 different high schools—learn and grow together.
- Participants meet, study and explore with professors and corporate researchers during a two week Summer Institute that is conducted on the campus of a large university and at numerous corporate research facilities.
- Students identify and conduct authentic research projects with guided assistance and support from university and corporate advisors throughout their junior year.
- Academic, career and enrichment opportunities extend student experiences beyond their regular classroom, school curriculum and environment.

Students participate in (REMS)^2 as an extension of their regular high school experience.

Key: Electronic Communication

Telecommunications is a key component of (REMS)^2. To facilitate this communication between students, teachers, and university and corporate advisors, schools are equipped with at least one computer and modem. All students and teachers are provided an account on EduNet, a statewide education network developed and operated by the Merrimack Education Center. Through EduNet, students and teachers are linked to one another and are also connected to the Internet, a worldwide network of networks.

This powerful electronic highway links participants to worldwide resources and communications. To ensure its effectiveness, the Merrimack Education Center provides leadership, technical support, and "care and feeding" of the network. A strong element of training is given to students and teachers in the use of e-mail, group conferencing, bulletin boards and research through the Internet. These efforts help to ensure that the electronic highway becomes a vibrant and dynamic medium of communication.

Early on students and teachers discover the excitement and effectiveness of instantaneous communications across the Merrimack Valley, the state and the globe. Having a pen pal, which many students experienced in previous school activities, takes on a whole new dimension when it's a "key pal." Unlike postal mail, which can take weeks, electronic messages are sent and received in a matter of seconds.

Through this first-hand experience, students are learning the ease and value that telecommunications can add to their research work by providing direct and instantaneous links to fellow students as well as corporate and university advisors.

Summer Institute

Students participate in a Summer Institute that is expressly designed to expand thinking; whet appetites; and provide hands-on experiences in both academic and research areas of the disciplines of biology, chemistry, computer science, engineering, environmental science, health sciences and mathematics. The Summer Institute is conducted on the campus of the University of Massachusetts-Lowell and numerous corporate sites.

By studying and exploring with professors and corporate engineers and scientists, students experience R&D in various environments. Students also have numerous opportunities to discuss possible college studies and careers. One goal of (REMS)^2 is to sustain interest and to encourage college studies and careers in science and engineering for all students, especially women and minorities. Both the university as well as corporations make special efforts to include women and minority scientists in the program, who serve as role and gender models.

Authentic Research

Throughout their junior year, students participate in a variety of enrichment activities including a research project. The work that students engage in during the Summer Institute helps them focus on an area of interest, define a reasonable project, and identify university and corporate advisors who are willing to provide them guidance and assistance. Research projects encourage problem solving and logical thinking as well as incorporate strategies that can be pursued individually or in teams with their peers from surrounding schools.

Advisors provide high-level expert support to help students bridge their academic interests to viable, authentic research. Students are supported and encouraged as they learn, share, synthesize, evaluate and construct. While conducting their research projects, students learn experimental design, laboratory skills, instrumentation, mathematical modeling, strategies for problem solving, and exploratory data collection and analysis.

Comprehension and understanding are emphasized in new situations where students do research under the guidance of experts. Because students are online with corporate and university advisors, they are able to use the "electronic highway" as a tool to support their research projects.

Important correlations are made between learning and thinking. What students learn is directly influenced by the context in which it occurs. The collaborative work skills, scientific research skills and discipline of mind that students learn by doing their own research is a major goal of (REMS)^2. Indeed, this outcome is more important than the actual research project results that students achieve.

Example Activity

Three students from Littleton High School—Laura Kanniard, Erin McGrath and Gretchen Faulkner—are testing water from Beaver Brook, which flows through a wetlands area of their town, for heavy metals, sodium and phosphates. Guided in their research by science teacher Fred Fitzpatrick, the students are using inexpensive test equipment to identify and monitor these elements and compounds. Additionally, weather and seasonal conditions are being tracked for possible collateral effects.

Linkages have been established with their town's water department, the University of Massachusetts-Lowell and the Cabot Corporation for assistance with using advanced laboratory equipment and processes for some of their testing. One research result that the students will analyze is a comparison of the data they get with inexpensive equipment to the results that can be provided with sophisticated equipment. Additionally, these students will have opportunities to exhibit and report their research to the local water department and Conservation Commission throughout the school year.

■ Outcomes

Now in its second year, this "virtual" school—which combines the focused attention of a magnet school with support resources and a powerful electronic network—is demonstrating a viable, active learning model with great potential for all students across America. ■

Burton Goodrich *is the associate director at the Merrimack Education Center, in Chelmsford, Mass.*
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Students identify and conduct authentic research projects with guided assistance and support from university and corporate advisors.

(REMS)²
REGIONAL ELECTRONIC MAGNET SCHOOL
Re: Math and Science

High Challenge Learning

NHSAA and NHSTE
Technology Conference
November 29, 30 and December 1, 1994

Presented by:

Dr. Burton Goodrich, Associate Director
Ms. Diane Boyajian, (REMS)² Project Coordinator

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Authentic Learning and Work

Authentic learning and work refers to tasks which are considered meaningful, valuable, significant and worthy of one's effort. Authentic learning and work includes both the culminating performances that display student achievement and to the daily activities undertaken to learn and prepare for the performance.

Fred Newmann

CURRICULUM IN TRANSITION

FROM

Information Dissemination

TO

Thinking, Learning and Performing in Significant Life-Roles and Contexts

Principles of Learning

1. New learning is shaped by the learner's prior knowledge.

2. Much learning occurs through social interaction.

3. Learning is closely tied to particular situations.

4. Successful learning involves the use of numerous strategies.

PRINCIPLES OF BRAIN-BASED RESEARCH

Finding #1. The brain is a parallel processor.
Implications for classroom practice: There is no best way, method or technique that fits all learners. The brain can handle logical thought, emotion, and imagination simultaneously. Since learning isn't a linear progression of discrete skills, teachers engage *all* students in problem solving, and don't make critical thinking or discussion of concepts contingent on mastery of routine or basic skills.

Finding #2. Learning engages the entire physiology.
Implications for classroom practice: Fatigue, nourishment, and exercise all influence the capacity of the brain to grow and process information. Brains, like children, develop at different rates. Expecting equal achievement based on age alone is not consistent with the way the brain grows.

Finding #3. The search for meaning in innate.
Implications for classroom practice: Children come into the world "ready to learn." They arrive at school with widely differing preparation for logical thinking, listening, and managing information. Their teachers can help them catch up in the cognitive skill areas of analysis, comparison, prediction, and hypothesis formation.

Finding #4. The brain processes information for patterns and resists having patterns imposed on it.
Implications for classroom practice: Enduring knowledge is more "constructed" than "received." Learning is a process of creating patterns from new information and prior knowledge. Children learn better by pursuing their own questions and responding to teachers questions, than by being given all the necessary information at once. Teachers recognize that learning is a social act and provide opportunities for students to work in small groups, of mixed abilities, taking on a variety of roles, in developing group product that demonstrate application of understanding.

Finding #5. Emotions are critical to patterning.
Implications for classroom practice: Feelings and attitudes determine future learnings. Teachers provide a motivational climate by connecting class work with real world tasks and personal experience. They emphasize the connections between effort and results.

Finding #6. The brain processes parts and wholes simultaneously.
Implications for classroom practice: Good teachers encourage students to develop dual sets of natural brain tendencies. One is to reduce information into parts; the other is to perceive and work with it as a whole or series of wholes, because parts and wholes are interactive.

Finding #7. Learning involves both focused attention and peripheral perception.
Implications for classroom practice: Effective instruction supplements the spoken word with charts and visuals to reinforce learning.

Finding #8. Learning involves conscious and unconscious processes.
Implications for classroom practice: Active learner processing of information allows students to review how and what they have learned. Teachers help students "think about their thinking" and reflect on how they learn well or poorly.

Finding #9. Learning involves at least two kinds of memory.
Implications for classroom practice: To increase the likelihood that concepts will be retained in long term memory, isolated facts and skills require more practice and rehearsal time.

Finding #10. The brain understands and remembers best when facts and skills are embedded in experience.
Implications for classroom practice: Teachers increase opportunities to learn by providing opportunity to work on real world problems, demonstrations, projects, field trips, role play, simulations, debates, visual imagery, stories, metaphor, drama, peer tutoring and the integration of different subject areas. They have students engage in self-evaluation and peer evaluation of work in progress.

Finding #11. Learning is enhanced by challenge and inhibited by threat.
Implications for classroom practice: Teachers extend invitations to inquiry, opportunities to explore natural phenomena. They establish a classroom atmosphere of high but unanxious expectation.

Finding #12. Individual learners exhibit unique learning styles and preferences.
Implications for classroom practice: Teachers use multifaceted approaches that allow all students to experience the subject matter through visual, tactile, emotional, and auditory preferences. They provide students with opportunities to make choices in classroom tasks, homework assignment, and exhibitions of learning within guiding frameworks.

LEARNING PRINCIPLES

1. People are born learners.
2. People seek to understand new information and experiences by connecting them to what they already know.
3. People learn in different ways.
4. Thinking about one's own thinking improves performance and the ability to work independently.
5. Individuals' stages of development affect learning.
6. Although people may naturally make connections as they lean, they often need help to transfer knowledge to different contexts.
7. A repertoire of strategies enhances learning.
8. Certain dispositions, attitudes, and habits of mind facilitate learning.
9. Working with others of different styles and perspectives enhances learning.
10. Those who do the work do the learning.
11. A resource-rich environment facilitates learning.
12. Developing shared understandings about what constitutes quality work fosters learning.

Source: Jill Merman, Pat Cox, and John Watkins. *Genuine Reward: Community Inquiry into Connecting Learning, Teaching, and Assessing.* Northeast Lab, 1994

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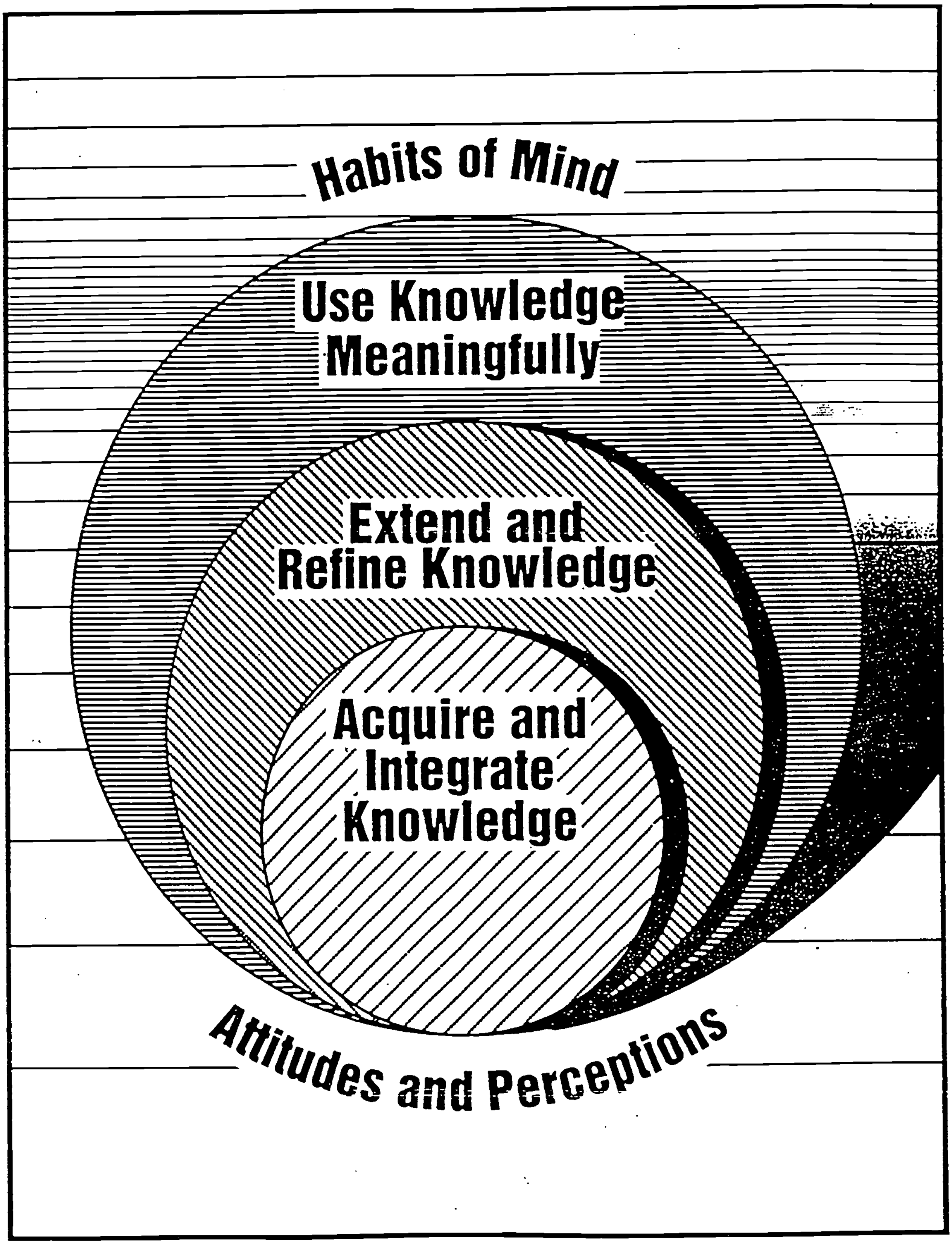
THE DIMENSIONS OF LEARNING



Gardner's Seven Intelligences

Bodily-kinesthetic:
ability to control one's body movements and to handle objects skillfully (dancer, athlete)

Intrapersonal:
access to one's own feelings and the ability to discriminate among them and draw upon them to guide behavior (therapist, social worker)

Interpersonal:
capacity to discern and respond appropriately to the moods, motivations, and desires of other people (teacher, salesperson)

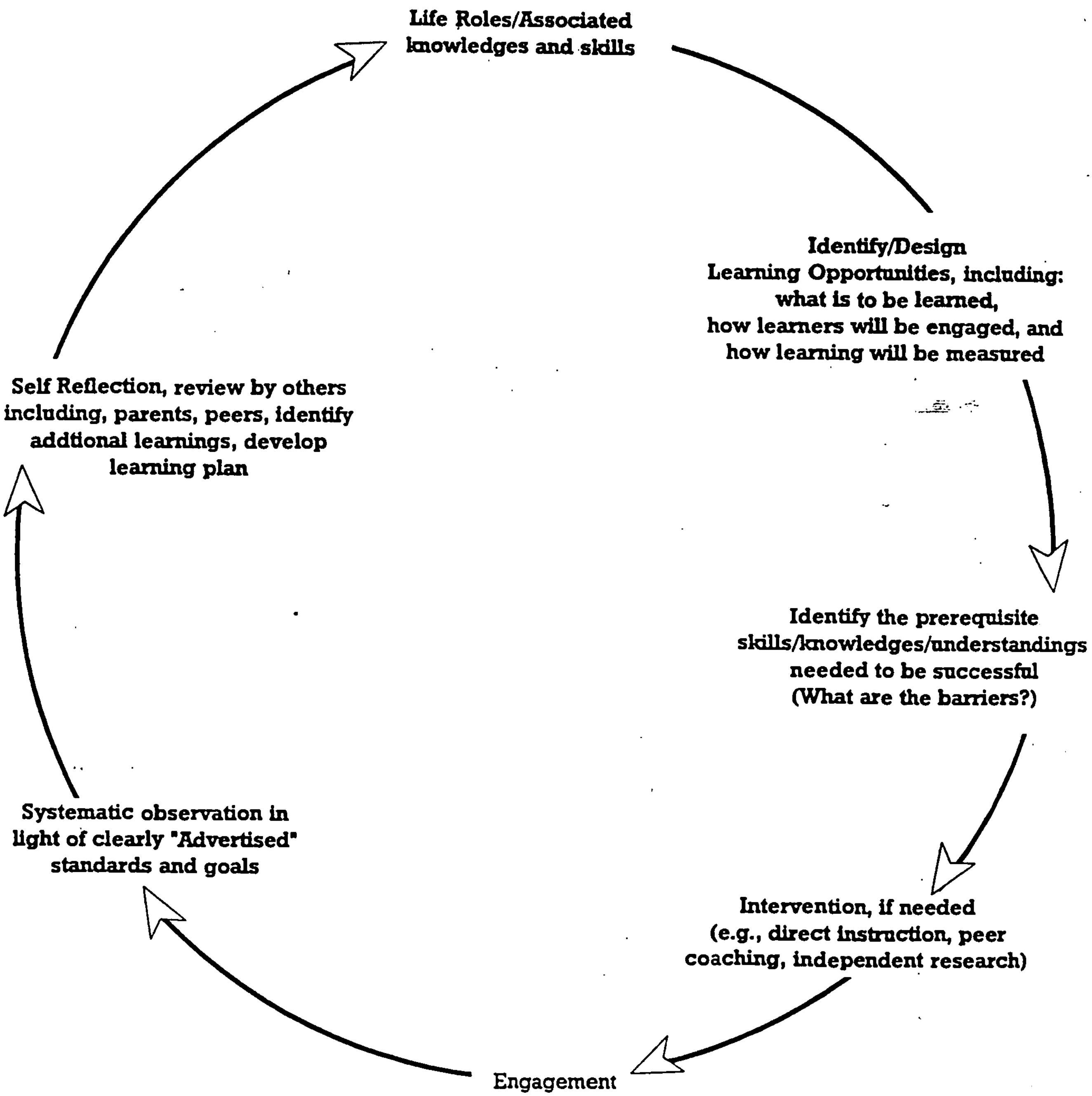
Spacial:
capacity to perceive the visual-spatial world accurately (navigator, sculptor)

Musical:
ability to produce and appreciate rhythm, pitch, and timber (composer, violinist)

Logical Mathematical:
sensitivity to and capacity to discern logical or numerical patterns (scientist, mathematician)

Linguistic:
sensitivity to the sounds, meanings, and rythms of words (poet, journalist)

LEARNING CYCLE



ce: CIMS Statewide Resource Team

Essential Elements of a Learning Opportunity

A learning opportunity is a unified set of tasks and activities organized around a theme, problem, project, or issue. It is a unit of instruction with the following components:

1. connected to life role contexts (personal, society, work)
2. relevant and interesting problems, issues, projects, or topics
3. opportunities for student choice
4. diverse learning resources, including technology tools and applications
5. flexible time structures
6. diverse organizational structures (school, classroom, sub-classroom)
7. use of discipline-based knowledge (e.g., Standards)
8. attention to learning styles and multiple intelligences
9. brain-compatible teaching and learning strategies
10. authentic assessment
11. prerequisite knowledge, skills, and motivations

Developing Learning Opportunities:

Key Components

- Life role performances in authentic contexts
- Enlarging concept of community of learners
- Business and community partnerships and special experts as instructional agents
- Audiences that have an authentic "need to know"
- Flexible learning environments
- Multiple options for grouping and scheduling
- Interdisciplinary themes and topics
- Genuine issues and problems
- Open-ended problems and divergent solutions
- Multiple options for presentation of results
- Investigation and research oriented
- Stress on the significance of learning for success in the future after school

Source: William Spady. High Success Network.

A Framework for Authentic Tasks

1. The task requires concepts, generalizations and processes that are considered critical to specific content areas.

2. The task requires one or more complex reasoning processes including: comparison, classification, structural analysis, supported induction, supported deduction, error analysis, constructing support, extending, decision making, investigation, systems analysis, problem solving, experimental inquiry, and invention.

3. The task requires students to gather information in a variety of ways (e.g., reading, interviewing, making observations, using computerized data bases) and from a variety of sources, some of which are primary sources.

4. The task allows for multiple and varied products such as oral reports, panel discussions, video-taped documentaries, and dramatic presentations.

5. The task is designed to provide a maximum amount of student control and regulation.

6. The task is highly amenable to cooperative/collaborative work.

7. The task focuses on issues that are relevant to the community and to the student.

8. The task is long term in nature, reflecting the depth of subject exploration and the use of higher-order thinking skills.

Mid-Continent Regional Educational Laboratory (McREL), Aurora, CO, March 1992.

Dimensions of Learning Opportunities

Low	to	High
simple	→	complex
routine	→	variable
concrete	→	abstract
structured	→	unstructured
recall of knowledge	→	evaluation of knowledge
directed	→	independent
conventional	→	innovative

New Directions in Learning Opportunities

- Toward classrooms as learning communities—away from classrooms of simply a collection of individuals

- Toward knowledge verification—away from the teacher as the sole authority for right answers

- Toward inquiry and reasoning—away from merely memorizing answers and procedures

- Toward conjecturing, inventing, and problem-solving—away from an emphasis on mechanistic answer finding

- Toward connecting subject areas—away from treating them as bodies of isolated concepts and procedures

$(REMS)^2$
Regional Electronic Magnet School

PLANNING, CONDUCTING, AND DOCUMENTING RESEARCH PROJECTS

$(REMS)^2$ Institute

July 17, 1995

Merrimack Education Center

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Regional Electronic Magnet School

The Research Process

Here's a "plain vanilla" outline of the research process:

1. Find a problem
2. Focus the investigation
3. Design the research
4. Collect data
5. Analyze data
6. Report findings and conclusions

What questions do you have about the process?

What steps do you anticipate will be difficult? Why?

What problems, issues, or topics interest you? Why? How might you go about setting up a research project about that problem, issue, or topic?

Ideas for Keeping a Journal

A preliminary note:

Think about a journal as a means of documenting and reflecting on your learning. It's a way of communicating with yourself and with others — a kind of autobiography — about your work.

There are no prescriptions for the content and format of a journal. The attached form outline is a suggested organization and can be customized to suit individual needs and circumstances. It is based on the assumption that you are employing a structured research process to guide your independent work. You will need to add specific questions relating to your project or area of investigation.

Sample Journal Content and Format

Learning Goals
What do I want to learn? Why?
What tangible and intangible products will result from my learning?
What will this learning lead to? What do I hope to do with my learning?

Question/Problem
What is the question/problem I want to address?
Why does it interest me?
What is it's significance in the real world?
What do I know about the question/problem already? How did I learn what I know?

Learning Plan
What are the specific questions I want to address?
Who is working on this question/problem?
How do I propose to address these questions? What is my workplan?
What problems do I anticipate? How will I address them?

Learning Process
What problems did I encounter in my learning? Were any unanticipated? How did I address them? With what results?
What did I change in my research (e.g., problem addressed, research process, resources used)? Why did I make these changes? What impact did these changes have on my learning?
What will I do differently in planning and conducting my future learning?

Learning Results
What have I learned? What is it's significance?
What products resulted from my learning? What did I do with the products?
What new questions have I identified to guide my future learning? What do I propose to do to address these questions?
With whom have I shared what I learned? What impact did my work have on others?

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(REMS)²
"Regional Electronic Magnet School Re: Math and Science"

PROJECT IDEAS

Below are some ideas that have been suggested at one time or another. For some, you will find additional information included. Also attached is a list of the projects that have been done in previous years. You can use them as a starting point for thinking of your own project.

- How do we prevent the depletion of ozone?
- What can be used as an alternative to freon?
- What can be used as alternatives to fuel for transportation?
- How can we use bacteria to decompose waste?
- Alternatives to laboratory testing on animals
- Cryogenics
- How can we treat brain aneurysms more effectively without damaging surrounding tissue?
- FEA (Finite Element Analysis)
- New technology and its uses in education
- Fractuals
- Fiber-optic computers?
- What are chaotic systems and what applications do they have?
- Applications of buckyballs and buckytubes?
- Chemometrics
- How were the pyramids built (and why)?
- Potential uses of ancient DNA (Jurassic Park?)
- Education – How we learn, learning disabilities, ability grouping
- Create a HomePage for the World Wide Web for your school/town
- EnviroNet project
- Organize a SCROUNGE effort in your school (program to help needy schools acquire computers for their classrooms). Additional information is included.
- Replace some of the current HS Chemistry labs with MicroChem labs (additional information is included)
- NASA Internet Initiative (additional information is included)
- "Chemistry and Crime: From Sherlock Holmes to Today's Courtroom" (additional information is included)
- Volunteer to develop science modules for elementary and middle school students (one example is included

PRESENTERS	PROJECT TITLE	SCHOOL
Robert Esplin	Computer Interface Program	Billerica Mem. HS
William Jennings	MUSE	Billerica Mem. HS
Marc Liberatore	MUSE	Billerica Mem. HS
Christopher Marshall	Neurosurgery	Billerica Mem. HS
Sarah Chen	MCET Project	Burlington HS
Emily Ko	Nutritional Analysis in Adolescents	Burlington HS
David O'Hearn	Computer Encryption	Burlington HS
Reshma Patil	Dermatology	Burlington HS
Alicia Pattison	Nutrition/Diet in Athletes	Burlington HS
Anh Kha	School Pond	Chelmsford HS
Jennifer Monahan	Pregnancy and AIDS	Dracut HS
Shaun Reilly	Biomedical Research	Dracut HS
Bhumika Shah	Cardiology	Dracut HS
Erin Woods	Multimedia Presentation	Dracut HS
Angel Rogriguez	Robotics	Grtr. Lawrence Reg HS
Efrin Cotto	Sports Information Project	Grtr. Lowell Reg. HS
Irene O'Flaherty	Efficacy of Astringents	Grtr. Lowell Reg. HS
Richard Burrier	Computer Controlled Device	Groton/Dunstable HS
Natasha Ginzburg	New Guide for Beginning EduNet Users	Groton/Dunstable HS
Erica Gross	Nutrition-How Different Amounts of Calories Effect Different People	Groton/Dunstable HS
Jennifer Haggerty	The Effects of Shallower Waters on Sightings of Fin and Humpback Whales During Summer Feedings Around Jeffrey's Ledge	Groton/Dunstable HS
Paul McCauley	Decomposition of Chemical Compounds	Groton/Dunstable HS
Tony Astolfi	Data Compression	Littleton HS
T. J. Blackburn	Astronomy	Littleton HS
Diana Belanger	Mercury Content in Snails	Littleton HS
Bryan McDonnell	Heavy Metal in Sediment Samples	Littleton HS
Amanda Olsen	Heavy Metal in Sediment Samples	Littleton HS
Amit Dhuleshia	The Stock Market - Chaotic Systems	No. Andover HS
Brian Tronic	Bicycle Redesign	No. Andover HS
Jeff Vogel	Bicycle Redesign	No. Andover HS
Andrew Wong	Bicycle Redesign	No. Andover HS
Josh Myles	MCET Project	No. Middlesex Reg. HS
Amanda Wolinski	The Effects of Differing Nitrogen Sources Upon the Growth of *Mb. thermoautotrophicum* strain ΔH	No. Middlesex Reg. HS
Debabrata Banerjee	Multimedia-Human Genome Project	Tewksbury HS
Shelley Thompson	Ethics-Human Genome Project	Tewksbury HS
Joy Yip	History-Human Genome Project	Tewksbury HS
Tammy Gambale	Vegetarianism: Effect on Rain Forests	Tyngsborough HS
Weylin Piegorsch	Computer Games	Tyngsborough HS
Elizabeth Sansone	Human Genome/Genetics	Tyngsborough HS
Julie Schermerhorn	Human Genome/Genetics	Tyngsborough HS
Christian Ferraro	Solar Car	Wilmington HS
Hung Nguyen	3-D Animation	Wilmington HS
Adam Volpe	3-D Animation	Wilmington HS

Research Projects

Presenters	Project Title	School
Michelle Ouellette	(REMS)^2 Multimedia Presentation	Billerica Mem. H.S.
Michael Phillips	(REMS)^2 Multimedia Presentation	Chelmsford H.S.
Karen Noyes	(REMS)^2 Multimedia Presentation	Dracut H.S.
April White	(REMS)^2 Multimedia Presentation	Dracut H.S
Anjali Dhond	Genetics	Burlington H.S.
Jeanne Restivo	Genetics	Burlington H.S.
Ishan Anand	Computers & the Information Age	Chelmsford H.S.
Leighton J. Core	Radon Testing	Dracut H.S.
Jessica Wilson	Environmental Awareness	Dracut H.S.
Becky DaSilva	Optimum Plant Growth Factors	Greater Lowell Reg. Voc. Tech.
Silvia Rocha	Coordinate Geometry Lesson-DERIVE	Greater Lowell Reg. Voc. Tech.
Timothy E. Baillio	Knee Injuries-Causes and Prevention	Groton-Dunstable Reg. H.S.
Samuel M. Pierce	Solar Power and Air Currents	Groton-Dunstable Reg. H.S.
Jonathan Stickel	Solar Power and Air Currents	Groton-Dunstable Reg. H.S.
Daniel Giaimo	Molecular Modeling Program	Littleton H.S.
Laura J. Kanniard	Water Quality	Littleton H.S.
Gretchen Faulkner	Water Quality	Littleton H.S.
Erin McGrath	Water Quality	Littleton H.S.
Nelly Godin	Effect of Nutrition on Cataract Formation	North Andover H.S.
Dan Leary	Hydroponics	North Andover H.S.
Katherine Terry	Particle Physics	North Andover H.S.
Sarah Bither	Wetlands Follow-up	Tyngsboro Jr/Sr H.S.
Lorin Petros	Wetlands Follow-up	Tyngsboro Jr/Sr H.S.
David Chouinard	Creating an Elementary School Curriculum	Tyngsboro Jr/Sr H.S.
Keith Collins	Creating an Elementary School Curriculum	Tyngsboro Jr/Sr H.S.
John Shaefer	Creating an Elementary School Curriculum	Tyngsboro Jr/Sr H.S.
Fernando F. Cucci	Lightning Energy Audit @ W.H.S.	Wilmington H.S.
Patrick H. Rufo	Diabetes - Insulin Control	Wilmington H.S.

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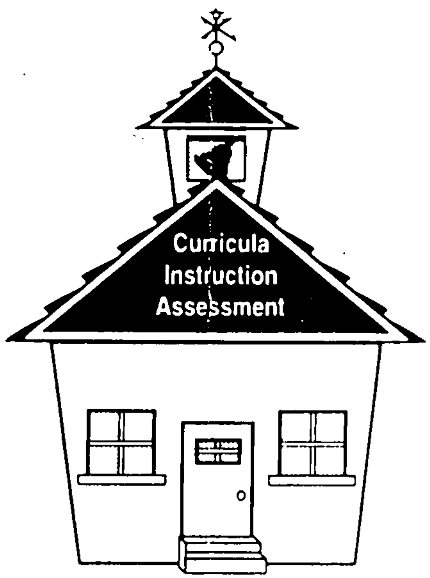

Electronic Networks and Technology

National Standards
State Frameworks
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Regional Electronic Magnet School

Workshops
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A Portfolio of Services and Resources to Support & Enhance School and District Systemic Improvement

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High Performance Learning

FAX: 978 256-6890

For assistance contact:
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E-mail: goodrich@mill.mec.mass.edu

7/18/94

SUMMER INSTITUTE

(REMS)2 Regional Electronic Magnet School Re: Math and Science

Week 1: July 18 – 22, 1994

MONDAY July 18	TUESDAY July 19	WEDNESDAY July 20	THURSDAY July 21	FRIDAY July 22
8:30 – 9:30 **Welcome and Introductions** Schedule of Activities Students/Teachers 9:30 – 11:30 **Team Project** 11:30 – 12:30 **Lunch and Social Time** 12:30 – 1:30 • **Research Projects** • **Keeping a Journal** 1:30 – 2:15 **Getting Ready for Academic Strands** 2:15 – 2:30 **Wrap Up**	8:30 – 9:00 **Intro to Day's Activities** 9:00 – 11:30 (1) **Hands-on Exploration** • Biology • Chemistry • Computer Sciences • Engineering (Chemical & Nuclear) • Health Sciences • Mathematics • Physics 11:30 – 12:30 **Lunch, Social Time, Team Projects** 12:30 – 2:15 (2) **Electronic Comm** (3) **Lab Visits** w/Grad. Students (4) **Journal Writing** 2:15 – 2:30 **Wrap Up**	8:30 – 9:00 **Intro to Day's Activities** 9:00 – 11:30 (1) **Hands-on Exploration** • Biology • Chemistry • Computer Sciences • Engineering (Chemical & Nuclear) • Health Sciences • Mathematics • Physics 11:30 – 12:30 **Lunch, Social Time, Team Projects** 12:30 – 1:30 (2) **Electronic Comm** (3) **Lab Visits** w/Grad. Students (4) **Journal Writing** 1:30 – 2:15 **Follow-up Summary for Each Strand** 2:15 – 2:30 **Wrap Up**	8:30 – 9:00 **Intro to Day's Activities** 9:00 – 1:30 (5) **Corporate Visits** 2:00 – 2:30 **Follow-up Summary of Corporate Visit**	8:30 – 9:00 **Intro to Day's Activities** 9:00 – 10:00 **EnviroNet Research Projects** **Paul Colombo, Karen Talentino** 10:00 – 11:30 **Team Project** 11:30 – 12:30 **Lunch with University Staff (Cookout hosted by MEC)**

Note:

(1) These are hands-on, interactive modules designed and taught by outstanding college faculty. These nine different sessions will be offered concurrently. Students will select one strand each week for a total of two different enrichment experiences. Approximately 6 – 8 students per session. Teachers will select modules to observe and then customize for use in their own school setting.

(2) Hands-on experience with computer applications, E-mail, conferencing, the Internet.

(3) Teachers will facilitate active dialog, observation, meeting with graduate students. Emphasize the graduate student's research, college studies and careers in math and science. Explore possible student research projects.

(4) Each student maintains a journal to record their various experiences and to plan their research project.

(5) These are active, engaging experiences to showcase research and create dialog between students and advisors, to show science and research in action, to help students identify corporations that have research and experts in areas of interest to them, to "flush out" the students' practicums, to get students and advisors working together. Eight to twelve corporate visits will be offered. Four or six different corporate visits will be conducted on day each week. Students will select one corporate site to visit each week for a total of two different visits. Approximately 15 – 18 students, accompanied by 7 – 9 teachers, will travel to a corporate site.

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$(REMS)^2$ Regional Electronic Magnet School
Re: Math and Science

CORPORATE AND UNIVERSITY ADVISOR PROGRAM

PURPOSE

The purpose of the **$(REMS)^2$ Regional Electronic Magnet School Re: Math and Science** is to support, guide, and assist students with their personal study and research experience in mathematical and scientific problem solving.

An advisor is a professional who can listen, provide scientific and research help for the student's area of interest, act as a role model and provide career information for students throughout their eleventh grade participation in the project.

GOALS

- To recruit, develop, and retain advisors whose vocational interests match those of the students.
- To recruit and retain advisors who are experts in a specialized field and possess a strong interest in teaching.
- To recruit and retain advisors who will provide opportunities for students to use their unique abilities to see their own potential.
- To expand support and resources for the advisoring program including other personnel.
- To recruit, develop, and retain advisors with high personal integrity and ability to enthusiastically communicate with high school students.
- To provide meaningful career information and entrepreneurial opportunities for young people.
- To provide an entree into "day on the job," "shadowing," and other career related events.
- To maximize the opportunities available through our unique location among the many scientific, technological, and medical facilities in the surrounding area.
- To maintain on-going communication among advisors, students, teachers, and the school.

DRAFT

DRAFT

MERRIMACK EDUCATION CENTER

REMS - Regional Electronic Magnet School

Strategies For Guiding Project Selection

1. Have students begin a journal before the summer institute.

2. Have students think about and write down reactions to the following statements:

A. In order of interest, list 5-10 areas that you enjoy learning about or would like to know more about. DO NOT limit your list to math and science only.

B. Try to determine if there is a connection between 2 or more of your interests. For example, if you like Chemistry and Mystery novels, perhaps a project on "Chemistry in the Courtroom" is in order.

C. Learn more about those areas that you have identified and narrow down your interest. For example, an interest in Biology might really be focused on your interest in Neurology; in turn, that may be narrowed to an interest in Brain chemistry and further to personality disorders.

D. Take the time to WRITE DOWN everyday things that you find interesting or puzzling. Be alert to any new idea (from school, newspaper articles, magazines, etc.) that sparks your interest. Again, don't limit yourself to math and science.

E. Spend some time researching some basics of three or four areas that you find most interesting.

F. Keep in touch with other REMS students and find out their ideas. Collaborative projects are encouraged.

G. Discuss your ideas with your REMS teachers, other teachers in your school, your family, friends, etc. Other viewpoints often help focus your ideas.

H. Remember, "all you need for a good idea is a lot of ideas".

3. Have students look over the Potential Projects List (see attached).

Using The Internet To Support Research

1. Send students to the Internet to join at least one listserv that is of interest to them. Use either or both of the following strategies:

   - Give them the Educator's Guide to Listservs
   - Have them LYNX to:
     http://www.clark.net/pub/listserv/listserv.html

2. Use the Internet to do a keyword search using VERONICA and/or the WebCrawler.

Potential Student Projects

1. How do we prevent the depletion of ozone?

2. What can be used as an alternative to freon?

3. What can be used as alternatives to fuel for transporation?

4. How can we use bacteria to decompose waste?

5. Alternatives to laboratory testing on animals?

6. Origin and causes of the illnesses in Arizona and New Mexico?

7. Cryogenics

8. How close are we to a cure for AIDS?

9. How can we treat brain aneurisms more effectively without damaging surrounding tissue?

10. FEA (Finite Element Analysis)

11. New technology and its uses in education.

12. Fractuals

13. Fiber-optic computers?

14. What are chaotic systems and what applications do they have?

15. Applications of buckyballs and buckytubes?

16. Chemometrics

17. How were the pyramids built (and why)?

18. Replace some of the current HS Chemistry labs with MicroChem labs

19. Potential uses of ancient DNA (Jurassic Park?)

20. Education - How we learn, learning disabilities, ability grouping,

21. "Chemistry and Crime; From Sherlock Holmes to Today's Courtroom"

22. Create a HomePage for the World Wide Web for your school/town.

23. Organize a SCROUNGE effort in your school (program to help needy schools aquire computers for their classrooms.)

24. Volunteer to develop science modules for lower grade students. (ie. there's a great one for hydroponics and aquaculture).

(REMS)² Regional Electronic Magnet School
Re: Math and Science

CORPORATE AND UNIVERSITY ADVISOR

Name: ______________________ Title: ______________________

Work Phone: ______________ Internet Number: (if available) ______________

Organization: ______________________ FAX: ______________

Work Address: ____

Profession: ____

Work Experience: ____

Educational Background: ____

Special Interests & Hobbies: ____

Previous Experiences with Young People: ______________________________
(Scouts, church, community)

Willing to Advise: _____ One Student Only _____ Group of Students (2–6)

Areas for which you are willing to serve as an advisor:

Subject	Specific Topic
i.e. Computer Science	Geographic Information Systems
______________________	______________________
______________________	______________________

Corporate Endorsement:

Name: ____

Title: ____

Relationship to Candidate: ____

Resume attached: _____ Yes _____ No

Please return to Burton Goodrich, Project Director, at:

Merrimack Education Center
101 Mill Road
Chelmsford, MA 01824
(508) 256-3985

April 13, 1993

ADDITIONAL MEC PROGRAMS

Other **MEC** Programs include:

- **EDUNET:** A computer network that links school districts for students, faculty and administrative uses. Currently serves Superintendents' networks in New Hampshire, Massachusetts, and the Massachusetts Corporation for Educational Telecommunications.

- **TECHNOLOGY ASSESSMENT AND NETWORK PLANNING:** For school districts and states - a systematic process for integrating technology into the curriculum and administrative functions. Provides for integration of voice, video and data communications.

- **PROFESSIONAL DEVELOPMENT**

  - **Graduate Degree Programs:** With affiliated State colleges, programs offer Field-Based Masters Degree Programs to local school districts. Includes study of school system priorities and supervised practicum in elementary, secondary or technology areas.
  - **Workshops and Institutes:** in various areas of curriculum, instruction, assessment and school leadership.
  - **Mini-courses:** in various aspects of technology including systems management, MAC and PC applications, distance learning and multi-media.

- **SPECIAL EDUCATIONAL PROGRAMS:** Assist schools in creating learning environments to serve the individual requirements of special needs students. Respond to locally-developed learning goals in support of mainstreaming. Include regionally operated programs for districts in Northeastern Massachusetts.

- **INFORMATION RESEARCH:** Provides links to information resource centers such as ERIC on promising programs and educational practices. MEC stores and shares information with other districts, and conducts research studies for school districts.

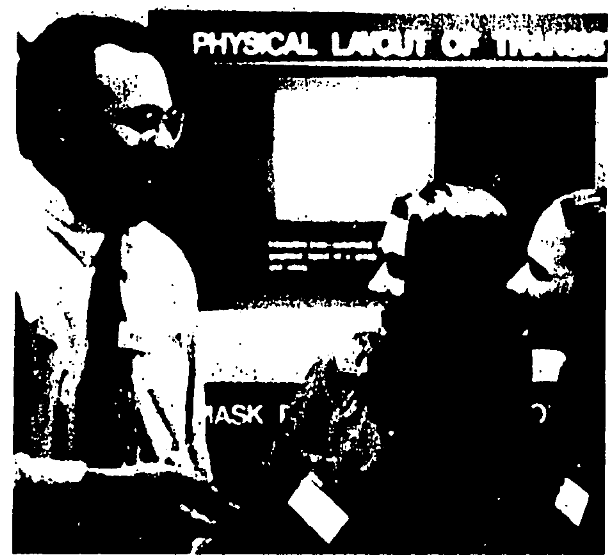
For further information, contact:
MERRIMACK EDUCATION CENTER
101 Mill Road, Chelmsford, MA 01824
508-256-3985 FAX 508-256-6890
goodrich @mill.mec.mass.edu

MERRIMACK EDUCATION CENTER

(REMS)²

REGIONAL ELECTRONIC MAGNET SCHOOL

RE: MATH AND SCIENCE



Conducted under a grant from the
U.S. DEPARTMENT OF EDUCATION,
JACOB K. JAVITS
GIFTED AND TALENTED EDUCATION PROGRAM

(REMS)² Regional Electronic Magnet School Re: Math and Science

VIRTUAL MAGNET SCHOOL
(REMS)² combines the best of two complementary but rarely connected strategies - the focused attention of a magnet school model for talented high school students and a powerful electronic network and resource system. The project draws on the teaching faculties of the state college and university system in the fields of math, science and engineering. Faculty members serve as instructors and guide student individual and group projects. Regional programs are conducted both at the university and at the MEC technology and staff development facility. The project fosters an active partnership between the school, university and various corporations.

Students, teachers, college faculty and project staff are connected with work stations on a computer network where electronic communication and conferencing will complement school-based teaching and learning activities. The network enables all participants to communicate through **"Internet"** providing a national and global perspective.

BACKGROUND AND PHILOSOPHY
(REMS)² expands background and interest in **Math, Science and Technology** through a stimulating two week **"Summer Institute"** and **"Junior Year"** learning and research experience. It provides enrichment opportunities that extend the regular school experience. The program's aim is to lead and challenge gifted students through exposure to current research problems and methods.

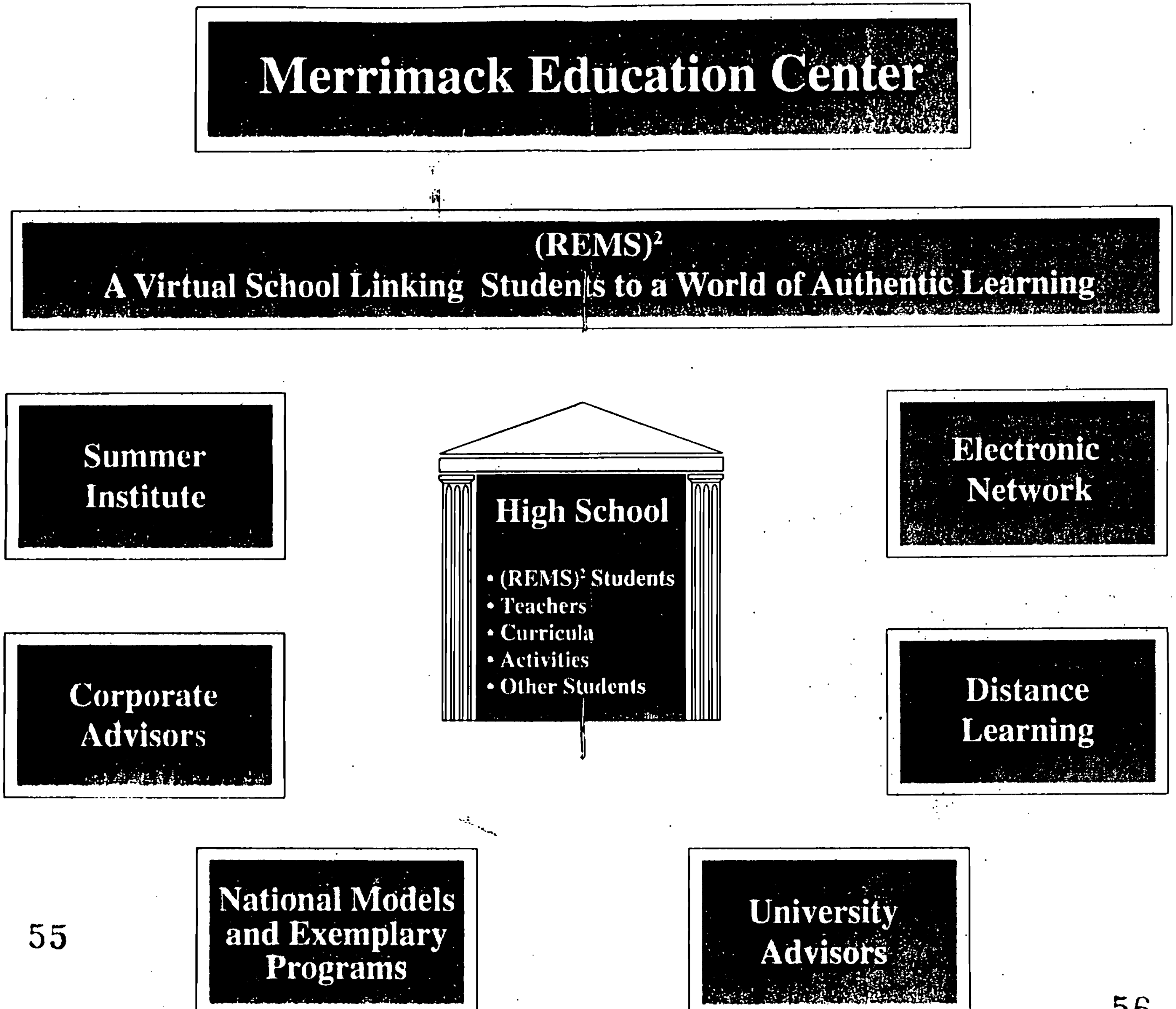
UNIQUENESS
(REMS)² is unique in many ways:

- Students remain in their own high school
- Approximately 56 students from 14 different schools across the Merrimack Valley participate
- The program includes a two week **"Summer Institute"** on the campus of **University of Massachusetts Lowell**
- Students participate during their junior year
- Students have enrichment and research opportunities with corporate advisors and college faculty that extend beyond their regular school program

PROGRAM DESIGN
The weekday **"Summer Institute"** is conducted for two weeks in July from 8:30 a.m. to 3:30 p.m. on the campus of **University of Massachusetts Lowell** and various corporate research sites.

The **"Junior Year"** program is conducted from September through June. Students participate in a variety of enrichment activities after school and weekends and students conduct research in areas of their own interest.

Topics of common interest, including general areas in **Math, Science,** and **Technology** are studied and explored. Students identify particular areas of interest and conduct research in those areas. Corporate and university researchers and scientists serve as advisors to support, guide, and assist students. Students participate in projects that encourage problem solving, logical thinking and incorporate strategies that are challenging and can be pursued individually and/or with their peers from surrounding districts. Students learn experimental design, laboratory skills, instrumentation, mathematical modeling, strategies for mathematical problem solving, and exploratory data analysis.


Merrimack Education Center
(REMS)²
A Virtual School Linking Students to a World of Authentic Learning
Summer Institute
Corporate Advisors
High School
• (REMS)² Students
• Teachers
• Curricula
• Activities
• Other Students
Electronic Network
Distance Learning
National Models and Exemplary Programs
University Advisors

ROLLMENT

(REMS)² is open to qualified secondary school students who will be entering their junior year of high school. Applicants must have demonstrated superior academic ability and interest in math and science. Individualized attention is provided by the program. Selection is competitive. A nomination from a high school mathematics or science teacher is essential.

STAFF

A faculty of master high school teachers, selected in the area of science and math, work in cooperation with professionals from college/university and industry in guiding students through academic programs especially designed to provide experience in scientific and mathematical problem solving. The principal instructors in the Summer Institute are professors, scientists and researchers. Advisors for Junior Year exploration and research are corporate and university researchers and scientists who can support, guide, and assist students with their personal study and research interests.

PARTICIPATING SCHOOLS (1993)

- Billerica Memorial High School
- Burlington High School
- Chelmsford High School
- Dracut High School
- Greater Lawrence Technical High School
- Greater Lowell Regional Vocational Technical School
- Groton-Dunstable Regional High School
- Littleton High School
- North Andover High School
- North Middlesex Regional High School
- Tewksbury High School
- Tyngsboro High School
- Westford Academy
- Wilmington High School

OBJECTIVES AND OUTCOMES

(REMS)² is an educational research project with the following goals:

- Organize regional and school based training programs for teachers and students from fourteen participating high schools, focusing on math/science advisor support projects.
- Establish a collaborative electronic network partnership with University of Massachusetts Lowell to support teaching and assist in dissemination.
- Identify and implement models that effectively utilize computer networking technology in both integrating and communicating beyond existing school and classroom boundaries.
- Establish a pilot project serving gifted and talented high school junior students.
- Demonstrate, evaluate and disseminate an electronic magnet school model in serving selected high schools throughout Massachusetts.

This project has produced a replicable model for addressing the needs of gifted and talented students using telecommunications and information technologies to create an electronic magnet school. The model is supported by comprehensive documentation of its development, implementation and impact on students, teachers and their schools.

Enrollment

(REMS)[2] is open to qualified secondary school students who will be entering their junior year of high school in September, 1994. Applicants must have demonstrated superior academic ability and interest in math and science. Individualized attention is provided by the program. Selection is competitive. A nomination from a high school mathematics or science teacher is essential.

Staff

A faculty of master high school teachers, selected in the area of science and mathematics, will work in cooperation with professionals from college/university and industry in guiding students through academic programs especially designed to provide experience in scientific and mathematical problem solving. The principal instructors in the Summer Institute are experienced teachers, professors, scientists and researchers. Advisors for Junior Year exploration and research are corporate and university researchers and scientists who can support, guide, and assist students with their personal study and research interests.

Costs / Transportation / Lunches

There is no fee for selected students. Students/parents are responsible for transportation to and from the Summer Institute and occasional after school and weekend activities during the Junior Year. During day-long meetings, students and parents will be responsible for reasonable lunch costs.

Application and Selection Timetable

Applications are accepted beginning in January, 1994. The deadline for receipt of all applications is February 28, 1994; those received after that date are reviewed on a space-available basis. Selection and notification of students will be completed by March 4, 1994 by each participating school.

For more information, contact:

(REMS)[2] Math & Science Teachers in Participating Schools or

Merrimack Education Center
101 Mill Road
Chelmsford, MA 01824
(508) 256-3985

Participating Schools

- Billerica Memorial High School
- Burlington High School
- Chelmsford High School
- Dracut High School
- Greater Lawrence Technical High School
- Greater Lowell Regional Voc Tech School
- Groton-Dunstable Regional High School
- Littleton High School
- North Andover High School
- North Middlesex Regional High School
- Tewksbury Memorial High School
- Tyngsborough High School
- Westford Academy
- Wilmington High School

JAVITS Gifted and Talented Education Program

This Regional Electronic Magnet School Re: Math and Science is funded through the United States Department of Education's Jacob K. Javits Gifted and Talented Education Program.

$(REMS)^2$ Regional Electronic Magnet School Re: Math and Science

Program Information Bulletin

Merrimack Education Center
101 Mill Road
Chelmsford, Massachusetts 01824

Type of Program.............. *Academic Enrichment*
Participants.................................*Rising Juniors*
Enrollment Limit.. *56*
Program Dates:
Summer Institute.......... *July 18 – July 29, 1994*
School Year........*September, 1994 – June, 1995*
Director of Program............ *Dr. Burton Goodrich*
Telephone..............................*(508) 256-3985x30*
Email....................*goodrich@mill.mec.mass.edu*

Background and Philosophy

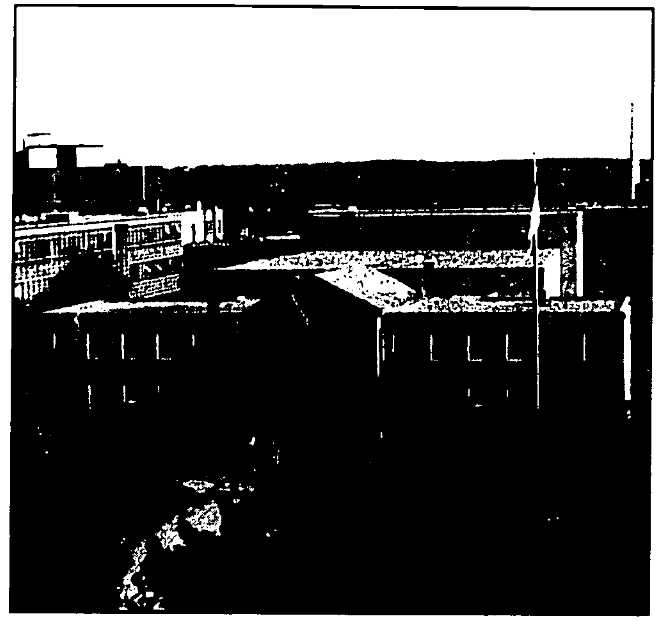
$(REMS)^2$ expands background and interest in Math, Science and Technology through a stimulating **two week Summer Institute and Junior Year learning and research experience**. It promises enrichment opportunities that extend the regular school experience. The program's aim is to lead and challenge gifted students through exposure to current research problems and methods.

Uniqueness

$(REMS)^2$ is unique in many ways:

- Students remain in their own high school
- Approximately 50 students from 14 different schools across the Merrimack Valley participate
- The program includes a two week Summer Institute on the campus of UMASS @ Lowell
- Students participate during their Junior Year
- Students have enrichment and research opportunities with corporate advisors and college faculty that extend beyond their regular school program

$(REMS)^2$ is a **"virtual school"** made possible by an **electronic computer network** connecting all students, teachers, college and corporate advisors. This electronic computer network is connected to the world!



Program Design

The weekday **"Summer Institute"** will be conducted from July 18 – 29, 1994 on the campus of UMASS @ Lowell and various corporate research sites.

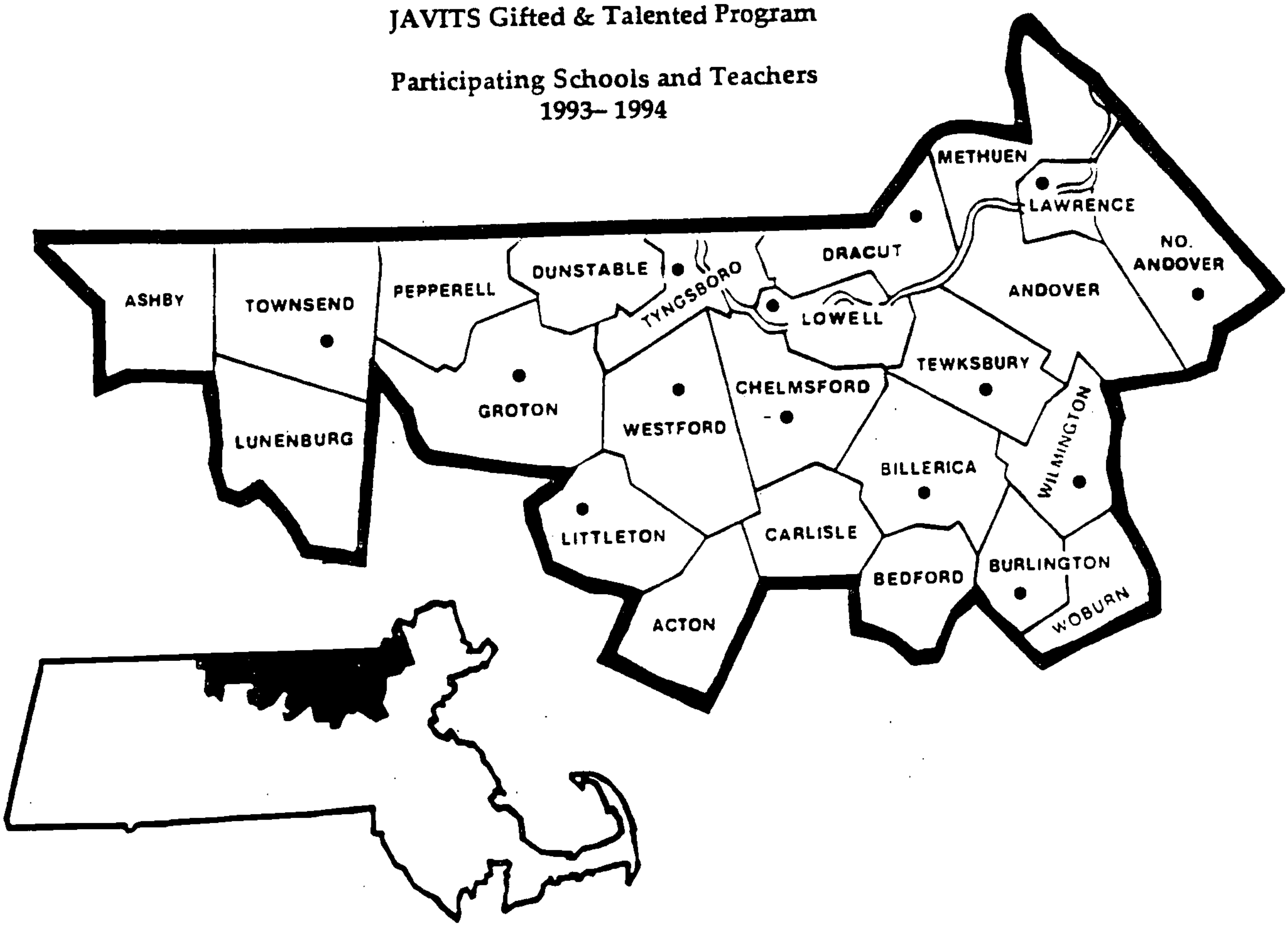
The **"Junior Year"** program will be conducted from September, 1994 through June, 1995. Students will participate in a variety of enrichment activities including after school and weekends, and students will conduct research in areas of their own interest.

Topics of common interest, including general areas in **Math, Science, and Technology will be studied and explored**. Students will identify particular areas of interest and conduct research in those areas. **Corporate and university researchers and scientists will serve as advisors** to support, guide, and assist students. Students will participate in projects that encourage problem-solving, logical thinking and incorporate strategies that are challenging and can be pursued individually and/or with their peers from surrounding districts. Students learn experimental design, laboratory skills, instrumentation, mathematical modeling, strategies for mathematical problem solving, and exploratory data analysis.

Figure 1

JAVITS Gifted & Talented Program

Participating Schools and Teachers
1993– 1994



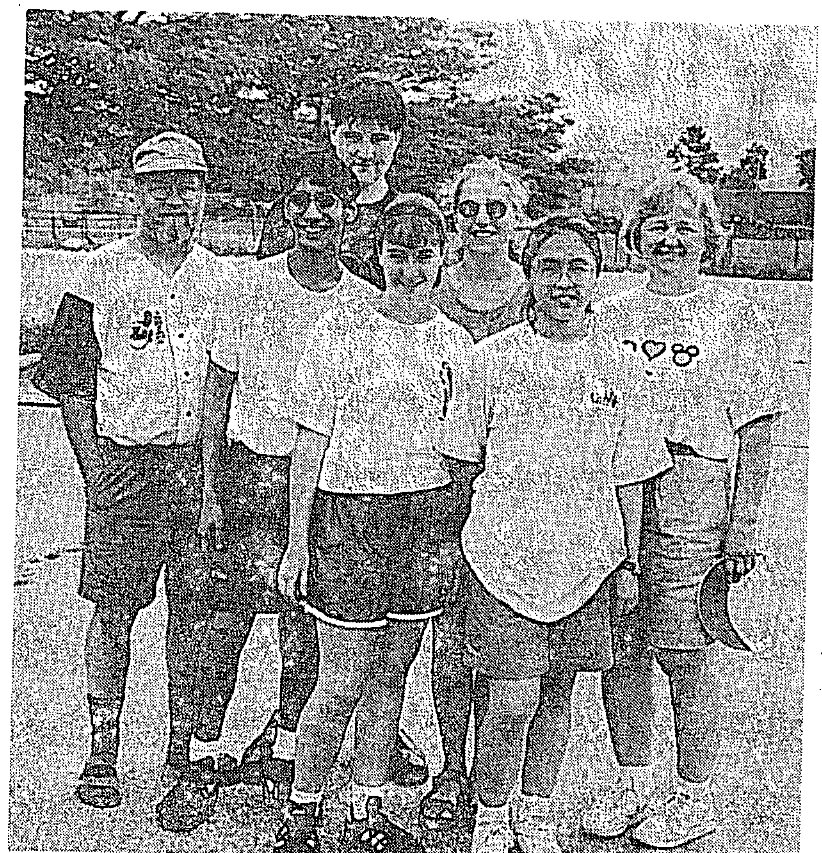
School	Math	Science
• Billerica High School	Maureen Cobleigh	Jack Flynn
• Burlington High School		David L. O'Hearn
• Chelmsford High School	Barry Bell	Michael F. Tate
• Dracut High School	Helen Asquith	Joseph J. Lapiana
• Greater Lawrence Technical High School	Doris Michaud	Howard Graichen
• Greater Lowell Regional Vocational Technical School	Ann Marie Buczek	Ernest Hebert
• Groton/Dunstable Regional High School	Melissa J. Pooler	Richard F. Lyons
• Littleton High School	Eric A. Turner	Fred Fitzpatrick
• No. Andover High School	Jeffrey M. Fuller	Robert Bennett
• No. Middlesex Regional High School	Fred Meshna	Stanley Kowalewski
• Tewksbury Memorial High School	Gerald S. Rideout	John Clarke
• Tyngsborough High School	Don Ciampa	John Egan
• Westford Academy	Ken Kravetz	Michael Kelly
• Wilmington High School	Kathleen H. Bell	James R. Megyesy

Local students attend REMS

Five juniors and two teachers from Chelmsford High School pursued advanced studies in math and science at the University of Massachusetts-Lowell this summer. The two-week institute was funded by the United State Department of Education's Jacob K. Javits Gifted and Talented Education Program and is part of the Regional Electron Magnet School program (known as REMS squared).

REMS is open by competitive selection to students who have shown superior academic ability and interest in math and science. Dr. Burton Goodrich of the Merrimack Education Center directs the program. Diane Boyajian is project coordinator.

Students engage in challenging and stimulating projects designed to provide experience in problem solving, working in small groups with a faculty of master high school teachers, professors from UMass-Lowell and other colleges, and corporate researchers. This summer, student teams designed and raced model solar cars, experimented with a mock infection to learn about the spread of disease, and studied sunspot activity with x-ray images downloaded from the World Wide Web.



Chelmsford High School participants in the Summer Institute in Math and Science at UMass-Lowell included teachers Mike Tate and Ann Swierzbin (left and right) and students Pranav Anand, Alex Kelly, Kristin Offt, Megan Mamalis and Vivian Hsu.

Participants from Chelmsford High School were teachers Mike Tate and Ann Swierzbin and students Pranav Anand, Alex Kelly, Kristin Offt, Megan Mamalis and Vivian Hsu.

During the school year, students will pursue independent research with the support and guidance of university and corporate advisors, culminating with an open house and presentations in the spring.

BEST COPY AVAILABLE

Welcome to the
(REMS)² OPEN HOUSE
at Westford Academy
April 24, 1996

AGENDA

EXHIBITS - Cafeteria	**6:00 - 7:45 pm**
HomePage Presentations: • *Tyngsborough HS* • *Groton-Dunstable HS* • *Chelmsford HS* • *No. Middlesex Reg HS*	**6:00 - 8:00 pm**
(REMS)² VIDEO - Exhibit Area	**Continuous**
REFRESHMENTS - Cafeteria	**6:00 - 8:00 pm**

PRESENTERS	PROJECT TITLE	SCHOOL
Karen Fallon	Physical Therapy	Billerica HS
Pranav Anand	Genetic Programming	Chelmsford HS
Vivian Hsu	Music Therapy	Chelmsford HS
Alex Kelly	Home Page for the Atom	Chelmsford HS
Arjun Masurkar	Biochemistry	Chelmsford HS
Kristin Offt	HomePage for CHS	Chelmsford HS
Chaitali Brahmbhatt	Physical Therapy/Case Study	Dracut HS
Samantha Cotter	Environmental Awareness Study	Dracut HS
Tim Deloge	Solar Fountain	Dracut HS
Jeff Dumont	Effects of Music on Memory	Dracut HS
Matthew Page	Environmental Club for Grade 3	Dracut HS
Mark Suprenant	Neurology	Dracut HS
Phe Tran	Psychology	Dracut HS
Craig Waddington	Robotics (Space Station)	Grtr Lawr. HS
Desiree Duran	Robotics (Space Station)	Grtr Lawr. HS
Brian Huot	Pollution in the Merrimack River	Grtr Lowell Voc
Sarah Samaros	Aroma Therapy	Grtr Lowell Voc
Melissa Tobin	Aroma Therapy	Grtr Lowell Voc
Brian Bergeron	HomePage Study Guide	Groton-Dunstable
Matt Bolduc	HomePage Study Guide	Groton-Dunstable
Charles Fitzpatrick	S.E.T.I.	Groton-Dunstable
Amanda McKenzie	Eating Habits of Teenagers	Groton-Dunstable
Suzanne Thomas	Eating Habits of Teenagers	Groton-Dunstable
Sarah Calhoun	Effects of sounds on brainwaves	Littleton HS
Michelle Eaton	Sediment and water testing	Littleton HS
Marie Hronik	Water testing and water quality	Littleton HS
Heather Magner	Water testing and water quality	Littleton HS
Michelle Toft	Hydrodynamics	Littleton HS
Michael Amante	HomePage for NMRHS	No. Middlesex
Zachary Bourque	HomePage for NMRHS	No. Middlesex
Steven Concordia	Visual Basic (Game)	No. Middlesex
Omer LeBlanc	Music and Instruments	No. Middlesex
Kerry Pothier	Ink Removal/Paper Recycling	No. Middlesex
Shara Shandrowski	Effects of Radiation on Seeds	No. Middlesex
Patricia Seymour	Effects of Radiation on Seeds	No. Middlesex
Phong Le	Vietnamese Karaoke	Tewksbury HS
Teja Salkar	HomePage for THS	Tewksbury HS
Dana Forti	Food Irradiation	Tyngsboro HS
Shawn Doczarski	Special Effects	Tyngsboro HS
Ryan McFarland	Criminology	Tyngsboro HS
Daniel Smith	Math/Music	Tyngsboro HS
Aaron Williams	Technology and Media	Tyngsboro HS
Cristen Duncan	Teaching Language to Chimps	Westford Academy
Lindsay Thomas	Effect of Sports Drinks	Westford Academy
Shaun Neville	Site Specific Water Treatment	Wilmington HS
Timothy Smith	Acid Rain/Snow	Wilmington HS
Andrew Tohmc	Fractal Patterns	Wilmington HS

Directions to Westford Academy

From Route 495 South:
Take Exit 32 (Westford/Boston Road).

Take a right off exit ramp and follow 1 mile to center of town (to stop sign), bear left.

Follow approximately 2 miles (winding road), look for Patton Road on the left.

Westford Academy is approximately 1/4 mile down Patton Road on the left.

From Route 495 North:
Take Exit 32 (Westford/Boston Road).

Take a left off exit ramp and follow above directions.

(REMS)²

REGIONAL ELECTRONIC MAGNET SCHOOL

RE: MATH AND SCIENCE

OPEN HOUSE

A celebration of sharing in research and learning

WEDNESDAY, APRIL 24, 1996
6:00 - 8:00 PM

WESTFORD ACADEMY
WESTFORD, MASSACHUSETTS

SPONSORED BY

MERRIMACK EDUCATION CENTER

Tyngsboro teen wows employer with tech smarts

By ANNE B. PRAMAS
Sun Correspondent

TYNGSBORO – The next time someone questions why students need to keep up with technology during school, Superintendent David Hawkins can point to a letter from an area employer.

Ryan McFarland was hired as a part-time sales associate at the Brookstone specialty store

Please see **TEEN**/6

TEEN/ from Page 1

at the Pheasant Lane Mall in Nashua last November. As part of a school project, Ryan spent three months developing a home page on the Internet for Brookstone.

"We were ... astonished at its high professional quality," William LaPierre, mail order marketing manager for Brookstone, wrote recently in a letter to Tyngsboro High School Principal Larry Kelleher. "We are proud to count Ryan as an employee, and Tyngsboro High School should be proud to have Ryan as a student."

Hawkins presented the letter with pride last night at the School Committee meeting.

Ryan's parents, Terry and Sharon McFarland of 1 Dupras Road, are proud as well.

"When he decides do something he puts forth all the effort necessary – above and beyond," Sharon McFarland said this morning. "He's a very mature 17-year-old."

So mature that he has a solid plan for the future, even though he still has his senior year ahead of him. Ryan joined the Army Reserve and is currently attending boot camp at Fort Sill, Okla. Next summer he will attend an Army technical school before he starts college. He hopes to study business marketing, his mother said.

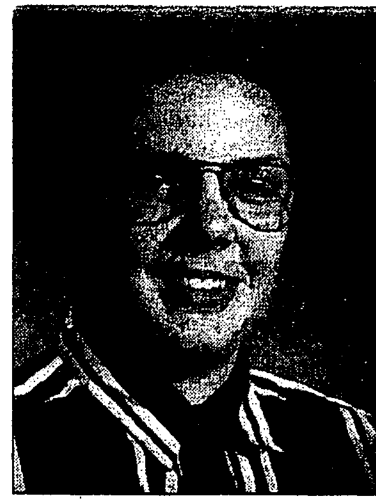
A National Honor Society member, he plays on the high school football and track teams and has a black belt in karate.

A home page is the equivalent of a storefront or front door on the Internet, which connects computers worldwide. The page can include text, pictures and sound. It can be linked to other home pages and has a potential readership of a million of people worldwide.

Ryan researched how the Internet has helped other companies before he set out to create Brookstone's home page.

McFarland's home page could appear on the Internet by September if it receives corporate approval. Brookstone is a 140-store chain based in Nashua that sells hard-to-find tools, gadgets and household products.

"I'd love to get this up and running. I think it could help the company more than anyone knows. (Brookstone) could



Ryan McFarland

quite possibly double their business with the amount of people that use the Internet," Kelleher quoted McFarland as saying.

Kelleher said McFarland came up with the project idea when searching for a topic of concentration for his REMS (Regional Electronic Magnet School) class.

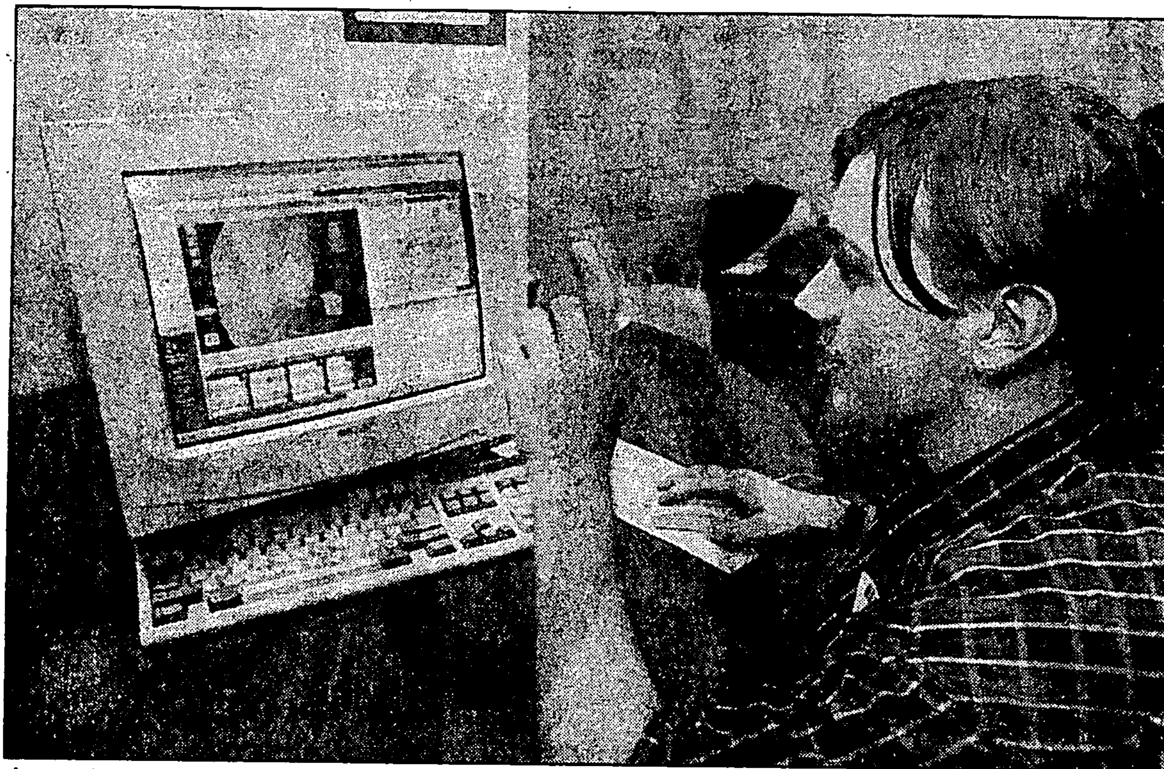
REMS is a Javits Grant program administered by the Merrimack Education Center in Chelmsford. The federal program allows participating students the opportunity to work independently on a topic of their choice. Those enrolled must be juniors who have demonstrated superior academic ability and have a genuine interest in math and science, said Kelleher.

McFarland chose the home page prototype because of his strong computer interests and the recent acquisition of some high-tech equipment and software by Tyngsboro High School, Kelleher explained.

Using the high school's Power McIntosh, Quik Take digital camera and Adobe PageMill Internet publishing software, McFarland was able to develop a home-page prototype that "rivaled in quality and scope, similar presentations we have from some of the best Internet providers in the industry, LaPierre said.

"He spent considerable time and energy photographing products, writing copy and developing a sound message for this project," according to LaPierre.

"The funny thing about this is we don't have a computer at home. He's done all of this in school," Sharon McFarland.


SUN/BOB WHITAKER

Aaron Williams, 17, of Tyngsboro, demonstrates 3-D graphics and programming.

Young scientists' finds and feats on display

By COURTNEY KING
Sun Correspondent

WESTFORD – Dracut High School student Mark Suprenant talks like a college professor and thinks like a scientist.

He plays trumpet in the school band and plays baseball on the JV team, and volunteers 20 hours a week feeding cells in the laboratory at the University of Massachusetts at Lowell.

He wants to find a cure for cancer.

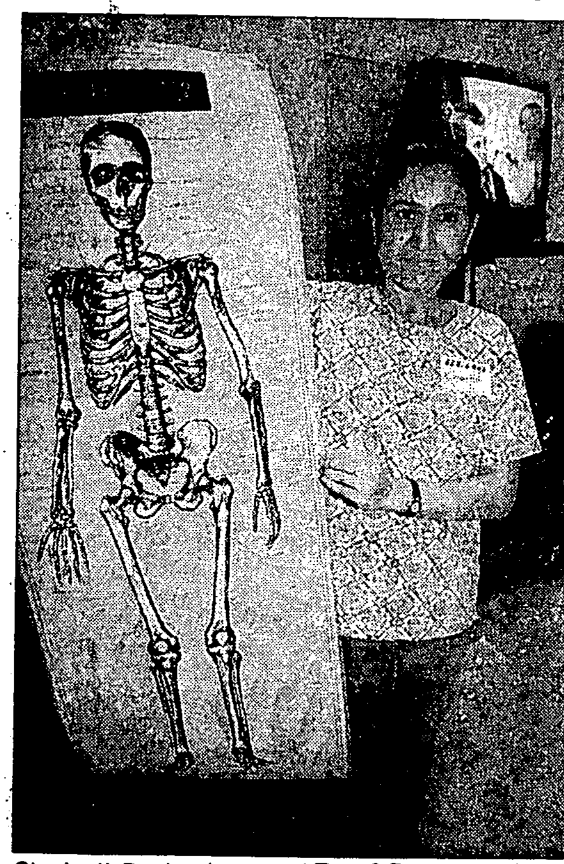
Last night, Suprenant and more than 45 other students from Greater Lowell communities showed off their projects at Westford Academy during an open house for the Regional Electronic Magnet School. REMS, funded through a three-year federal grant, is a "virtual" school that links 14 area high schools, universities and businesses.

Suprenant showed off his project, called "*Inhibition of Mitosis Induces Differentation on Human Neuroblastoma Cells: Therapeutic Implications.*" Neuroblastoma is the most common solid cancerous tumor found in children.

Recently Suprenant attended a meeting of neurobiologists at Northeastern University, which he would like to attend. He said most of the presenters were graduate students or representatives of laboratories.

"I was the only high school student," he said.

Please see SCIENCE/19


SUN/BOB WHITAKER

Chaitali Brahmbhatt, 17, of Dracut, with part of her physical therapy display.

Young scientists' finds and feats on display

SCIENCE/From Page 17

"I was in such amazement. I couldn't believe I was with such high company, and they were very interested in my work."

Shara Shandrowski, a student at North Middlesex Regional High School in Townsend, presented a project about the effects of radiation on plant life. She has worked with professors at UMass-Lowell.

"What we have found is that any seeds exposed to radiation are discolored and the leaves are cracked," she said, "and any seed exposed to over 30,000 rads of radiation do not grow."

Tyngsboro High School student Shawn Koczarski studied special effects in movies. Among his findings: Artists drew approximately 1.2 million leaves for *Toy Story*; like most other Disney movies, *Toy Story* took about four years to make; *Beauty and the Beast* was the first Disney movie to transfer computer images directly to film without changing to cells.

Dracut High student Samantha Cotter, who would like to be a pharmacist, studied environmental awareness. "Every Christmas there are enough trees cut down to cover the state of Rhode Island," she said.

Shaun Neville, a student at Wilmington High School, was the youngest displayer, with a project on site-specific water treatment.

"I tried to design a settling tank for companies to clean their water. Right now when the water goes out it is only 20 percent cleaner than when it comes in," he said.

Amanda McKenzie and Suzanne Thomas, students at Groton-Dunstable Regional High School, based their project on teen-agers' eating habits.

In studying how nutritional their school lunches are, they found that school lunches are high in fat but also high in nutrients.

Westford Academy's Maureen Karpinsky, a twin, studied twins. She gathered opinions and searched the World Wide Web.

Perhaps none of the students had the research access of Suprenant, who studies with Thomas B. Shea at UMass-Lowell. Sometimes, Shea lets Suprenant borrow a key to the lab.

"I consider myself a person in the pyramid that is contributing to cures," Suprenant said. "Someday, when I am old and gray, somebody may look at something I did and contribute it to a cure."

REMS Student Participates in University Alzheimer's Research

Mark Surprenant, a junior at Dracut High School, has been afforded a unique opportunity to work with an area neurobiologist and new faculty member on University of Mass Lowell Campus. This unique experience resulted from Mark's exposure to Alzheimer's Research that had been done by Dr. Thomas Shea, the neurobiologist.

During the Regional Electronic Magnet School (REMS) summer institute 1995 for students which is open to Dracut's gifted and talented students, Mark met Dr. Shea while participating in a biology academic strand. At that time Dr. Shea offered participating REMS students the opportunity to work in a research lab that he directs. Together with his graduate students they would work on basic Alzheimer's research.

Mark took advantage of this special opportunity and began working with Dr. Shea. The research he's participated in involves the division of neurons (nerve cells). Mark has been working with Mitotic Inhibitors (substances that stop cell division) in an attempt to understand basic changes that occur in the nervous system. Both Mark and Dr. Shea have been very excited with the results of Mark's experiment, which will be released when Mark publishes, under the advisorship of Dr. Shea, in a professional science journal. Publishing in such a prestigious science journal is a unique experience for any high school junior. As if publishing alone were not exciting enough, together with Dr. Shea, Mark will present his findings before a gathering of neurobiologists this spring at Northeastern University.

Faculty advisors, Helen Asquith and Joseph Lapiana feel that this project is a true indicator not only of the ramifications of the REMS project for Dracut High but also how Dracut High School in collaboration with the local University can provide high challenge learning opportunities to any student interested in advancement. This also shows how Dracut High School can access special resources not normally available to a High School community.

Program

BANG'96

Boston Area Neuroscience Group 1996

Annual Meeting
at
Northeastern University
Ell Student Center
March 18, 1996
5:30-9:30 P.M.

Keynote Lecture

"GAP43 and other molecules important in neural development and plasticity"

by
Dr. Larry Benowitz
Children's Hospital
Harvard Medical School
6:30-7:30 P.M.
Ell Student center Ballrooms

Hosted by Northeastern University Departments of Pharmaceutical Sciences and Psychology

J.W. Balbich#, A.J. Fischman#, B.K. Madras@, and P.Melzer^. *Northeastern University, Massachusetts General Hospital, @Harvard Medical School, and ^Organix.

G7. Synthesis and preliminary evaluation of C-11 labeled RS 86, a selective muscarinic cholenergic agonist, as a potential tracer for monitoring Alzheimer's disease with PET. **R.N. Hanson*, J.W. Babich#, D.R. Elmaleh#, and A.J. Fischman#.** *Northeastern University, and #Massachusetts General Hospital.

G8. The pharmacokinetic behavior of two N-[L-11]methyl-labeled beta-substituted and unsubstituted phentermine tracers in the Rhesus monkey brain as metabolism resistant analogs of amphetamine. **R.N. Hanson*, D.R. Elmaleh#, A.L. Brownell#, J.W. Babich#, and A.J. Fischman#.** *Northeastern University, #Massachusetts General Hospital.

G9. Synthesis and labeling of [^{125}I/^{18}F]N-benzylpiperidin-4 ido/flurobenazimide as a sigma receptor ligands. **R.N. Hanson*, Sung Woon Choi*, D.R. Elmaleh#.** *Northeastern University, #Massachusetts General Hospital.

G10. Synthesis and imaging of nonhuman primates with the acetylcholine agonist [C-11]arecoline: Preliminary evaluation. **R.N. Hanson*, D.R. Elmaleh#, J.W. Babich#, A.L. Brownell#, M.A. Crowley#, A.J. Fischman#** *Northeastern University, #Massachusetts General Hospital.

G11. Simultaneous measurement of sub-femtomole amounts of norepiniphrine, dopamine, and serotonin in microdialysis samples using HPLC-EC. **P.K. Mishra*, R.L. Burger*, P.C. Jobe*, J.K Cullison, M.L. Bowers, and I.N. Acworth.** *Univeristy of Illinois and #ESA Inc.

G12. Estimation of brain free radical production following systemic salicylate: Limited effects of glutaminergic and dopamergic pathways. **D.R. MaCabe*, I.N. Acworth*, and T.J. Maher#.** *ESA Inc and #Massachusetts College of Pharmacy.

G13. An hisotological approach to identify viability of microdialysis probe usage in the striatum of freely-moving rats. **S.R. Bossi*, I.N. Acworth*, T.J. Maher# and J.Yu#.** *ESA Inc. and #Massachusetts College of Pharmacy.

Neuronal Disease and Excitotoxicity (2nd floor)

H1. The bradykininantgonist RMP-7, selectively and transiently increases uptake into rat brain tumor. **M.R. Huff et al.** Pharmacology Department, Alkermes Inc., Cambridge MA.

H2. Neurochemical and cellular mechanisms of RMP-7, a tumor-selective adjuvant treatment for neuro-oncology. **C.C Pien et al.** Pharmacology Department, Alkermes Inc., Cambridge, MA.

H3. RMP-7 increases carboplatin uptake into brain tumors: optimization of dosing paradigms. **D.G. Blunt et al.** Pharmacology Department, Alkermes Inc., Cambridge, MA.

H4. RMP-7 increases uptake of carboplatin into rat gliomas: Comparison of three cell lines. **T.L. Nagle et al.** Pharmacology Department, Alkermes Inc., Cambridge, MA.

H5. Intravenous RMP-7 selectively opens the guinea pig blood-retinal barrier. **P.A. Snodgrass, et al.** Pharmacology Dept. Alkermes Inc., Cambridge, MA.

H6. Induciton of neuronal differentiation by inhibition of mitosis: Implications for neuroblastoma cancer therapy. **Mark Superenant and Thomas B. Shea.** Dracut Sneior High School and Department of Biological Sciences, University of Massachusetts - Lowell.

H7. Transplantation of CNS stem-like cells as possible therapy in a mouse model of spinal cord dysfunction. **Jonathan D. Flax, Shaoxiong Liu, and Evan Y. Snyder.** Children's Hospital and Harvard Medical School.

H8. Beta Amyloid Peptide (1-42) Depresses Evoked ACh Release in Cultured Ciliary Ganglion Neurons. **S. Miller, N. Jacobsen, and B. Gray.** Simmons College.

UNIVERSITY OF MASSACHUSETTS LOWELL
COLLEGE OF ARTS AND SCIENCES

Department of Mathematics

July 5, 1996

Dear Burt,

Here is a copy of the published version of the problem Justin Ryan posed two summers ago in the $(REMS)^2$ program. I'm trying to get a copy of the entire issue of the journal for you; if I'm successful, I'll pass it along.

Hope you are enjoying the summer.

Steve Pennell

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CMJ Problems
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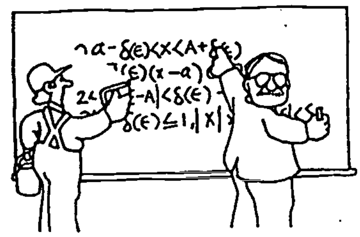
PROBLEMS AND SOLUTIONS



This section contains problems that challenge students and teachers of college mathematics. We urge you to participate actively by submitting solutions to the published problems and by proposing problems that are new and interesting. To promote variety, the editors welcome problem proposals that span the entire undergraduate curriculum.

Whenever possible, a proposed problem should be accompanied by a solution, appropriate references, and any other material that would be helpful to the editors. Each proposal or solution should be typed or printed neatly on separate sheets of paper, with your name and affiliation (if desired) on each page. Include a self-addressed, stamped envelope if you want us to acknowledge having received your contribution. Submissions may be sent via e-mail to cmj@lclark.edu or mailed to Roger B. Nelsen.

Solutions to the problems in this issue should be postmarked no later than August 15, 1996.

PROBLEMS

576. *Proposed by Peter Daffer, Macon College, Macon, GA*

Let $f(t) = t - at^2, a > 0$. Write $f^n = f \circ f \circ \cdots \circ f$ for the n-fold composition of f with itself, and let f^0 denote the identity function. For what values of t does $\sum_{n=0}^{\infty} f^n(t)$ converge?

577. *Proposed by K. R. S. Sastry, Dodballapur, India*

A convex heptagon $A_1A_2A_3A_4A_5A_6A_7$ is such that the angle at A_1 is 90° and $A_iA_j \| A_kA_m$ for $i + j \equiv k + m \bmod 7$. Prove that

$$\frac{\sin 2A_2}{\sin 2A_5} = \frac{A_5A_6^2}{A_2A_3^2}.$$

578. *Proposed by Robert Patenaude, College of the Canyons, Valencia, CA*

Determine the lengths of the sides of a triangle with the properties that (i) the sides have integral length and (ii) one angle is twice as large as another.

579. *Proposed by Justin Ryan (student), Westford Academy, Westford, MA, and Steve Pennell, University of Massachusetts, Lowell, MA*

Let (x_1, y_1), (x_2, y_2), and (x_3, y_3) be three points in the xy-plane with $x_1 < x_2 < x_3$. For a given line $y = mx + b$, define $S(m, b)$ to be the sum of the vertical distances from the three points to the line, i.e., $S(m, b) = |y_1 - (mx_1 + b)| + |y_2 - (mx_2 + b)| + |y_3 - (mx_3 + b)|$. Find the line that minimizes $S(m, b)$.

The College Mathematics Journal

(REMS)^2

Regional Electronic Magnet School Re: Math and Science

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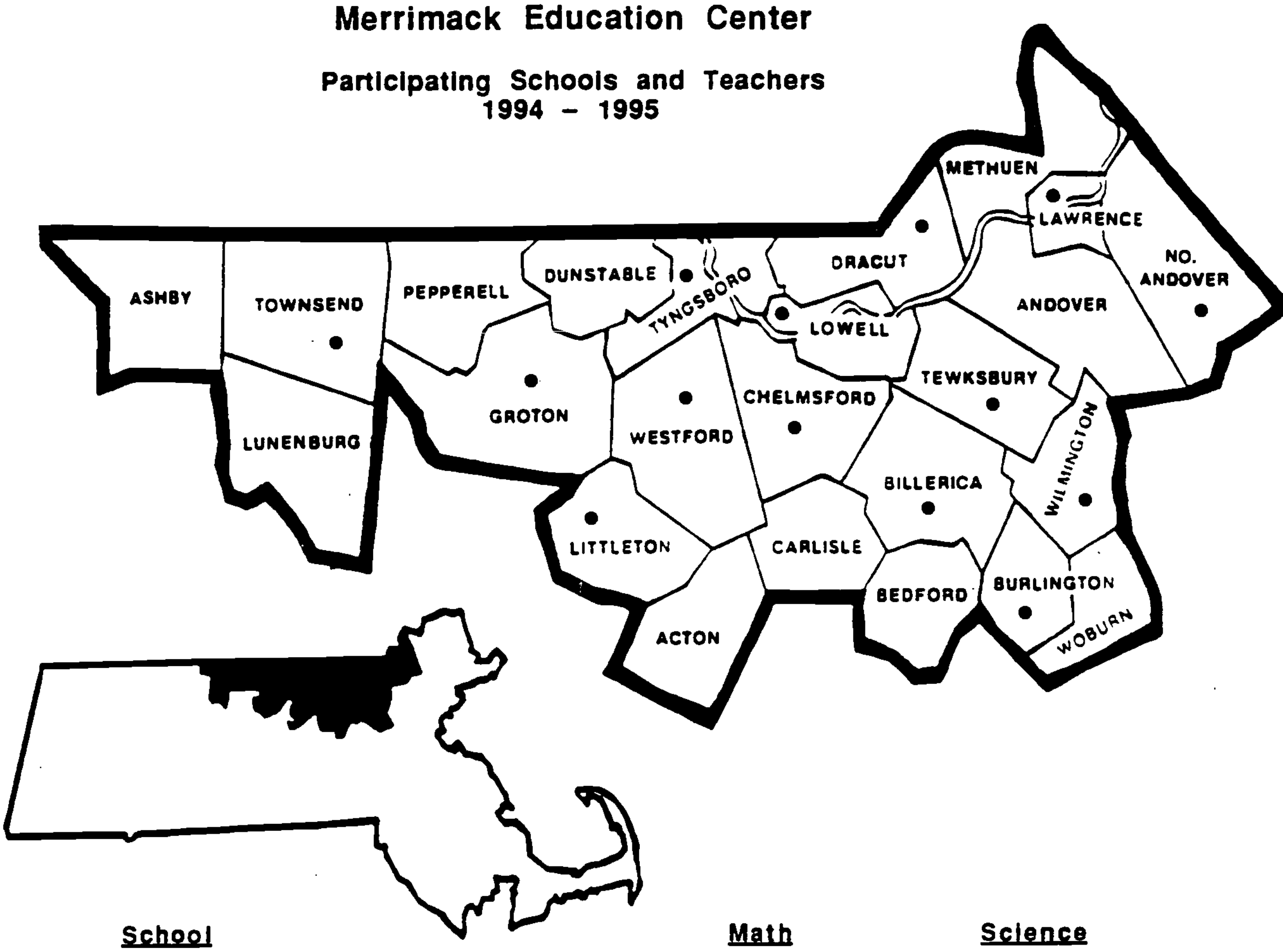
1994 - 1995



School	Math	Science
• Billerica High School	Stanley Warden	Jack Flynn
• Burlington High School		David L. O'Hearn
• Chelmsford High School	Ann Swierzbin	Michael F. Tate
• Dracut High School	Helen Asquith	Joseph J. Lapiana
• Greater Lawrence Technical High School	Doris Michaud	Howard Graichen
• Greater Lowell Regional Vocational Technical School	Ann Marie Buczek	Ernest Hebert
• Groton/Dunstable Regional High School	Melissa J. Pooler	Richard F. Lyons
• Littleton High School	Eric A. Turner	Fred Fitzpatrick
• Merrimack School	Michele LeMay	
• No. Andover High School	Jeffrey M. Fuller	Robert Bennett
• No. Middlesex Regional High School	Mary McDermott	Stanley Kowalewski
• Tewksbury Memorial High School	Gerald S. Rideout	John Clarke
• Tyngsborough High School	Don Ciampa	Jim Walsh
• Westford Academy	Ken Kravetz	Michael Kelly
• Wilmington High School	Kathleen H. Bell	James R. Megyesy

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