MINUTES

MONTANA HOUSE OF REPRESENTATIVES
53rd LEGISLATURE - REGULAR SESSION

JOINT SUBCOMMITTEE ON EDUCATION & CULTURAL RESOURCES

Call to Order: By Chairman Royal Johnson, on February 15, 1993, at 8:00 a.m.

ROLL CALL

Members Present:
Rep. Royal Johnson, Chair (R)
Sen. Don Bianchi, Vice Chair (D)
Sen. Dennis Nathe (R)
Rep. Ray Peck (D)
Sen. Chuck Swysgood (R)

Members Excused: None

Members Absent: Rep. Mike Kadas

Staff Present: Taryn Purdy, Legislative Fiscal Analyst
Skip Culver, Legislative Fiscal Analyst
Doug Schmitz, Office of Budget & Program Planning
Amy Carlson, Office of Budget & Program Planning
Curt Nichols, Office of Budget & Program Planning
Jacqueline Brehe, Committee Secretary

Please Note: These are summary minutes. Testimony and discussion are paraphrased and condensed.

Committee Business Summary:
Hearing: UNIVERSITY SYSTEM
Executive Action: NONE

HEARING ON UNIVERSITY SYSTEM

Tape No. 1:A:000

SIMMS, EPSCoR, and CENTERS for EXCELLENCE

Informational Testimony:

Dave Toppen, Associate Commissioner of Higher Education, began his presentation by distributing **EXHIBIT 1** which summarized the differences between the SIMMS project (Systemic Initiative-Montana Math and Science), EPSCoR program (Experimental Program to Stimulate Competitive Research) and the Montana University System (MUS) Centers for Excellence. He noted that the SIMMS project was initiated by the National Science Foundation two years ago under a Statewide Systemic Initiative (SSI) grant. It was not a research program, but a program to elevate the scientific, mathematics and problem solving skills of Montana

youth. The request was for continued general fund matching support of $1 million annually.

Dr. Toppen explained that EPSCoR was created in the early 80's to stimulate basic research in five states which NSF had identified as the worst at attracting federal R&D funds. Originally first known as MONTS (Montana on a New Track for Science), this program had resulted in a three-fold increase in funding from NSF, and a ten-fold increase in funding from the NIH. He added that research productivity had also risen to a total of $40 million. He noted that other federal agencies were initiating their own EPSCoR programs and that it had been hoped that general funds would be available for matching grants. Knowing the limitations imposed by the state financial crisis, it was now expected that loans from the Montana Science and Technology Alliance (MSTA) would be utilized.

Dr. Toppen explained the function and funding of the state-initiated Centers for Excellence. With funding obtained through the MSTA and monies from the Coal Tax Trust Fund, three centers were established in 1987-88. **EXHIBIT 1** All of the centers have been successful at obtaining outside funding. He mentioned that there would be a special presentation on the Engineering Research Center of Excellence (ERC) located at MSU which was one of only 18 such centers in the U.S. designated by NSF. The center focuses on microbial interface process engineering. He said that they would be requesting continued general fund support for the center at a rate of $200,000 per year. Finally, he referred to the last page of **EXHIBIT 1** which summarized the matching fund requests for the programs he spoke about.

Dr. John Lott, University of Montana Math Instructor, Representative for the SIMMS Project and for the Montana Council of Teachers of Math, explained that the SIMMS Project was designed to help secondary students in mathematics and eventually in science. He noted that in mathematics test scores Montana leads the nation, but overall the scores are still low when compared to those of other industrialized nations. This project was the result of a five-year, $10 million grant from NSF to the Montana Council of Teachers of Mathematics. It involved the cooperation of the OCHE, OPI and various colleges and universities. The grant requires matching funds from the state of $1 million per year, but funding through private sources is also involved. **EXHIBIT 1**

Dr. Lott then distributed a series of exhibits to explain the type of work SIMMS does and how it affects math education. **EXHIBITS 2-13** One of the goals of SIMMS is to devise new materials for students studying math which have more meaning than present materials. He referred to two newspaper articles which reviewed some of the curriculum changes and the impact on students. **EXHIBIT 2 and 3** He then presented a sample teaching module called "Oil: Black Gold" which would be used in the classroom. **EXHIBIT 4** It was typical of the materials which are

being developed to present mathematics in context so that students can make informed decisions. **EXHIBIT 5** was a summary of the new definition of mathematics.

Dr. Lott elaborated on the present objectives of SIMMS. **EXHIBIT 6** He mentioned that the curriculum being designed was meant for all students as defined in **EXHIBIT 7**. **Dr. Lott** referred the committee to **EXHIBIT 8** which listed all of the participants in the Montana SIMMS project. He noted 56 teachers who spent the summer developing the teaching modules now being used and the 20 schools where new technology was added for use in the math curriculum. He then presented **EXHIBIT 9** which summarized the impact for technology on the math curriculum and the rationale for its incorporation. **Dr. Lott** summarized by saying that SIMMS was producing a set of students who can and will know more about mathematics than the previous generation knew when it graduated from school and referred the committee to **EXHIBIT 11** which was a letter from NSF reminding **Dr. Lott** that the NSF grant was one that required a match from the state.

Gail Gray, OPI, spoke in support of the SIMMS project emphasizing the significant partnership that has developed between the public and private sectors. The cooperation between public agencies was also noteworthy. She emphasized that the project was innovative, integrative and in its infancy.

Robert Swenson, Vice-President for Research at MSU, presented **EXHIBIT 14** and noted it was important to invest resources wisely and that this meant a small investment by the state could yield tremendous returns from outside funding. He pointed out that a relatively small amount of state money had been invested in both the SIMMS project and the ERC and the return has been outstanding. The $5 million of state money funding SIMMS has generated $40 million. The $1 million in ERC will be generating $16 million. The success of these two programs has made the state's educational institutions more competitive for other grants.

Dr. Swenson noted that Montana was unique in having all three programs: SIMMS, EPSCoR and ERC. He said it would soon be announced that Montana was successful in obtaining a highly competitive NSF grant for a Teachers Collaborative Project. This grant for $5 million requires no state match and will be used to train secondary mathematics teachers to use the curriculum designed by the SIMMS project. Another grant which was obtained because of the state's initial investment in SIMMS etc. was a $5 million NSF grant for a Native American K-12 Science and Math Educational Program.

Dr. Swenson referred to **EXHIBIT 14** to inform the committee of the reason for developing ERCs and a history of their function and their objectives. He mentioned that NSF would be investing $7.5 million in the ERC at MSU over a five-year period and would be expecting only a $200,000 matching grant from the state each

year. He presented to the committee copies of letters of commitment from Governor Stephens and from David Darby, Director of OBPP. **EXHIBIT 14** He mentioned that the commitment had been pivotal in obtaining the NSF grant because of the highly competitive nature of the grants. The only other biotechnology centers were at Duke University and MIT.

John Sears, Chemical Engineer at MSU and Interim Director of ERC, stated that the center considers itself the best center in environmental biotechnology and environmental engineering. He stressed the unique partnership of NSF, MSU, the state and 20 industrial associates which was providing funding for the development of technologies to be used in the state. He listed the areas of technology development. **EXHIBIT 14** He noted that the centers with the five-year NSF grant were expected to last at least 11 years with funding from the NSF, the state and the private sector. **Mr. Sears** pointed out the unique interdisciplinary nature of the educational process at the center where there was a mixture of chemists, microbiologists, statisticians and engineers learning and working together.

Dr. Toppen reiterated that NSF grants had been good to Montana because they helped to create a science infrastructure which made it possible to obtain even more outside funding. He mentioned that three years ago NSF faulted the state for not having a science and technology development plan. With funding and assistance from MSTA, a plan was developed which NSF now uses as a model around the U.S.. In 1992, the Montana Science and Technology Agenda was published outlining a direction for the state. He stressed that the various research, technology and educational initiatives were all part of the overall plan developed under the directions indicated by the agenda.

Questions, Responses, and Discussion:

SEN. DON BIANCHI noted that Governor Stephens made the commitment to fund the ERC for five years at $200,000/year. He asked **Dr. Sears** if the state was committed to funding the program at that rate for the remainder of its 11-year duration. **Dr. Sears** explained that in 1994 the center will reapply for funding from NSF and at that time a commitment from the state would probably be helpful in obtaining an extension of the initial grant.

CHAIRMAN ROYAL JOHNSON asked **Dr. Lott** how many hours he taught mathematics per week. **Dr. Lott** explained that until January of last year he had been chairman of the department and also was working on the SIMMS project. Each represented one half of his work load. In January of last year his work with the SIMMS project became his full-time job although he did teach one seminar. He added that he was only working with graduate students at this time.

CHAIRMAN JOHNSON asked how much money **Dr. Lott** was anticipating he would receive from the MSTA fund for the SIMMS Project this

year. **Dr. Toppen** explained that the SIMMS project has obtained its support from the general fund, while EPSCoR and ERC have obtained support from the MSTA. Because SIMMS was not a research program, it could not obtain funding from MSTA. He added that the research and development activities over the last biennium at the university system have received approximately $3.1 million in support from MSTA.

CHAIRMAN JOHNSON asked **Dr. Toppen** to elaborate on the coordination plans in place to prevent duplication in various programs involved. **Dr. Toppen** mentioned that up to about three years ago research enterprises were independently managed on individual campuses. With the involvement of MSTA, expectations were made clear that coordination of research efforts on individual campuses needed to occur to avoid costly duplication and to encourage collaboration. He also noted seven federal agencies who want to spend money in Montana **EXHIBIT 1** and stated that all of them requested a single point of contact and coordination, and multiple campus involvement in every stage of every research project. Through collaboration, duplication in expensive instrumentation is reduced. MSTA has through its grants and loans purchased much of the instrumentation and has been insistent that resources be shared. NSF has also demanded reassurance from the state that unnecessary duplication has not occurred.

Tape No 1:B:000

Dr. Toppen continued to explain that there was now one contract with MSTA through the OCHE rather than separate contracts with the individual campuses. This increased coordination of resources. **CHAIRMAN JOHNSON** asked what the rate of return was on the projects. **Dr. Toppen** answered that originally it was contracted that five percent of the proceeds in any given year from royalties, patents etc. would be paid back to the Coal Tax Trust Fund through MSTA up to a total of 2.5 times the original loan. He added that Montana was the only state that had these types of activities supported through loan rather than through grants. Because the rate of payback is slow in the early stages, the university system has agreed to pay back from whatever sources are appropriate, a minimum of $250,000 per year. (The present indebtedness was $3.5 million system-wide.) To meet this commitment, all the income from royalties and patents and other similar sources would be directed to pay back the $250,000 each year.

CHAIRMAN JOHNSON closed the hearing on the SIMMS, EPSCoR and ERC.

CHAIRMAN JOHNSON asked **SEN. DENNIS NATHE** if he was ready to introduce his bill called An Act Creating a Poplar River Ground Water Special Revenue Account. **SEN. NATHE** said he wished to review the bill first because there was a reference in it to the 14.1% and the $666,000 for the ground water assessment and he was concerned that someone would try to access those proceeds for other reasons if the present wording remained. The committee

agreed to wait.

Taryn Purdy, LFA, presented **EXHIBIT 15** which delineated the present status of the committee in relationship to its reduction target. She said that although she had neglected to insert the new allocations for the six university units, the bottom line was still accurate. Presently, the committee was about $414,116 from its general fund reduction target of $25 million. This figure did not include any action contingent on the passage of other bills.

SEN. BIANCHI asked if there were any other programs pending for a decision by the committee beside SIMMS and ERC. **Ms. Purdy** said the only additional requests would be if the Regents came back. **Doug Schmitz, OBPP,** mentioned there was a modification in OPI which was contingent on HB 106 that might affect the committee's target. **Skip Culver, LFA,** noted that the Human Services Subcommittee had taken action that removed Medicaid for instate treatment of emotionally disturbed children. This action impacted this committee's action to give OPI $2.6 million for the education of the same children.

Mr. Schmitz pointed out to the committee that the SIMMS proposal was not in the executive budget. He said that in the summary budget there was a line for miscellaneous appropriations of $1.75 million for each year of the biennium. Governor Racicot has indicated that $1 million of the $1.75 million could be used each year to fund the SIMMS project. **Ms. Purdy** noted that funding SIMMS would affect the committee's target because SIMMS was not contained within the LFA budget.

ADJOURNMENT

Adjournment: 9:00 a.m.

REP. ROYAL JOHNSON, Chair

JACQUELINE BREHE, Secretary

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HOUSE OF REPRESENTATIVES

EDUCATION **SUB-COMMITTEE**

ROLL CALL **DATE** 2-15-93

NAME	PRESENT	ABSENT	EXCUSED
REP. ROYAL JOHNSON, CHAIRMAN	✓		
SEN. DON BIANCHI, VICE CHAIRMAN	✓		
REP. MIKE KADAS		✓	
SEN. DENNIS NATHE	✓		
REP. RAY PECK	✓		
SEN. CHUCK SWYSGOOD	✓		

SIMMS, EPSCoR and the MUS Centers of Excellence

A brief summary on certain state-wide extramural efforts in the University System

I. SIMMS (Systemic Initiative - Montana Math and Science)

Purpose:	Through initiation by the Governor, bring about state-wide systemic changes in the way we teach, learn and use science and mathematics to enhance the nation's international competitiveness and the welfare of our citizens. SIMMS is not a research program; it is a program to elevate the scientific, mathematics and problem solving skills of Montana youth.
Program Duration:	5 years (through FY 1996)
Source of Funds:	50% National Science Foundation, 50% State ($1M each per year)
Who's Involved?	Montana State University University of Montana Office of Public Instruction Montana Power Company Apple Computer, IBM, Zenith US West Addison-Wesley Book Company Numerous School Districts Montana Council of Teachers of Mathematics Many other groups
Fiscal Management?	Accounting and fiscal management of the program is provided by MSU - without charge.
Other states?	There are 23 states with State-wide Systemic Initiative (SSI) grants from the NSF. Montana was one of the first.
Request:	Continued General Fund matching support of $1,000,000 annually

EXHIBIT 1
DATE 2-15-93
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EXHIBIT 1
DATE 2-15-93
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II. EPSCoR (Experimental Program to Stimulate Competitive Research)

Background? EPSCoR was created in the early 80's to stimulate basic research in the 5 states which NSF had identified as the worst at attracting federal R&D funds. In Montana the program was called MONTS (Montanans on a New Track for Science).

Effectiveness? Among numerous accomplishments, NSF-EPSCoR has led to a three-fold increase in NSF funding in Montana, a 10-fold increase in research funding from the National Institutes of Health, and successful implementation of the NSF engineering Center at MSU. NSF-EPSCoR (as MONTS) has been the single most important influence in increasing research efforts system-wide to the current $40M level. Significantly, EPSCoR activities stimulated the creation of the Montana Science and Technology Plan (NSF identified the need, Governor Stephens created the Science and Technology Council and MSTA funded the project).

Other States? Through Congressional action the original 5 states have expanded to now include Nevada, Idaho, Montana, Wyoming, North and South Dakota, Nebraska, Iowa, Oklahoma, Alabama, Arkansas, Kentucky, Louisiana, Mississippi, Vermont, West Virginia and Puerto Rico.

Other Agencies? Other federal agencies are now following NSF-EPSCoR with the creation of their own EPSCoR programs. Unfortunately, these programs are emerging from Congress as we deliberate. EPSCoR active agencies are:

Agency	Proposal Due	$matching
NSF	Submitted	$1.5M/$1.5M
Energy	March 1, 1993	$625K/$625K
EPA	April 30, 1993	$200K/$200K
NIH	Spring, 1993	?/?
NASA	?	?/?
Defense	?	?/?
Agriculture	?	?/?

Funding Source: State matching dollars for EPSCoR activities are typically supported by appropriations from general funds or designated trust funds in other states. However, recognizing the added burden this puts upon the general fund at this time, and the difficulty in obtaining a direct appropriation from the Coal Tax Trust Fund, we are prepared to request support for all EPSCoR activities in the '93-'95 biennium in the form of loans through the Montana Science and Technology Alliance (MSTA).

EXHIBIT
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III. Centers of Excellence

State Initiated Centers: In 1987-88, with respective start-up grants of $200K each, the Montana Science and Technology Alliance (MSTA) initiated three state designated "centers of excellence." These were (i) the Biotechnology Center of Excellence (UM, MSU), (ii) the Center for Synthesis and Characterization of Advanced Materials (MSU) and the Center for Advanced Materials Processing (Tech). In the following biennium the MSTA created the Center for Entrepreneurism, with a head office at UM and branches at EMC and MSU. The effectiveness of the centers in establishing a research agenda and attracting external funds has varied from center to center - largely as a consequence of varied missions - but there have been great successes. For example, the Center at Montana Tech, while spending less than $170,000 of MSTA funds in the 91-93 biennium, has already attracted over $5M in federal grants and contracts.

Request: Support will be requested from the Montana Science and Technology Alliance.

National Center: Over the past decade, and through strenuous competition, the National Science Foundation has designated 18 national "Engineering Research Centers of Excellence (ERC's)." At Montana State University, the Center for Interfacial Microbial Process Engineering has been designated as one of these highly distinguished research organizations. In the three or so short years of the Center's designation by NSF, and with an initial investment of $200,000 by MSTA, the Center has already obtained over $5M in federal and corporate grants and contracts.

Request: The ERC at MSU is currently the most prominent jewel in Montana's R&D crown. A general fund appropriation to provide continued support of $200K per year in the '95 biennium is requested.

EXHIBIT 1
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IV. Summary of Montana University System Matching Fund Requests for SIMMS, Centers of Excellence and EPSCoR Activities

Activity	FY '94	FY '95	Source
SIMMS	$1,000,000	$1,000,000	General Fund
Engineering Research Center	$200,000	$200,000	General Fund
State Centers of Excellence			
Hazardous Materials (Tech)	$150,000	$150,000	MSTA
Biotechnology (UM,MSU)	$200,000	$200,000	MSTA
Entrepreneurism (UM,MSU,EMC)	TBD	TBD	MSTA
EPSCoR			
NSF	$1,500,000	$1,500,000	MSTA
Energy	$650,000	$650,000	MSTA
EPA	$200,000	$200,000	MSTA
NIH, Defense, NASA, Agriculture	?	?	MSTA

EXHIBIT 2
DATE 2-15-93
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ath adding up to real life

Gazette photo by Larry Mayer

Teacher Lisa Wood works on an experiment with students Lora Christiansen, Dave Weyler, Aaron "Bon Bon" Berklund and Scott Anderson.

dents used eye-droppers full of motor oil to squeeze drops of oil onto sheets of toilet paper, simulating a simplified oil spill. The experiment built a mathematical model of an oil spill, which would help them describe the event or predict something about it. Students also learned to determine the area of circles and irregularly shaped figures, about volume in containers and graphing the inverse variation of volume, demonstrating that as the height increases, the base decreases.

Object lesson

One of the first modules Wood taught was a project dealing with the population growth of "skeeters." Using candy pieces that have an "S" on one side, students would shake the pieces up, spill them onto the table and count the ones with an S showing — those were the ones that reproduce. By continuing that process, students got a picture of successive generations, and found a pattern for exponential growth. They graphed the information, then learned to write an equation from the graph.

"It's really quite a process," Wood said.

Another module — each one takes from about 10 days to three weeks — taught students about census-taking, which included reading charts and tables. They learned how to take a census, how it differs from a survey and how data can be manipulated to get what the census-taker wants. They used their new computers to do spreadsheets to organize the data they gathered. They learned when to use a pie chart or a bar graph.

"It's taking the emphasis away from the teacher, and putting more on the students," Wood said, watching the groups of three or four students huddle in front of their computer screens. "I give them direction, not lectures."

Students figure out the patterns, the relationships and the answers themselves, with the teacher acting as facilitator. It's a giant step away from traditional teaching methods in math, Wood said.

Students enthusiastic

"The kids love it, not being assigned 15 factoring problems," she said. "And they'd go home and do them, then come back and find out if they're right."

The other thing the students like is that what they're learning applies to real life. In other classes, students so often ask, " 'What are we ever going to use this for?' " Wood said. "You never hear that here."

And yet, she said, the class covers all the material students should know after ninth-grade math. "There's no way a math teacher is going to let kids out of high school without knowing what they need to know."

Actually, Wood said, students are "getting a lot of hard-core math, but they don't know it. They're enjoying it."

At West High, where Margaret Plouvier and Jerry Fisher are each teaching four modules to their classes, students are taking a little longer to adjust to the new method of teaching math.

"It's very new to students," said Plouvier, who said she has completed only one module so far, and is alternating them with regular math. "They're a little bit resistant to change."

(More on Math, Page 5C)

School	Amount awarded	Matching funds
Central	$14,000	$12,500
Senior	$15,000	$15,000
Skyview	$20,000	$20,000
West	$16,000	$16,000

EXHIBIT 2
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four years, and received $10 million in fur
m the National Science Foundation in
r 1991. The Montana Legislature added
for this year, the project's first year in t
, with the intent of providing another $4 m
er the next four years. So far, Johnny L
e $2 million for the next two years is in
education budget, as well as in the gov
udget.
hools that received funding from the proj
is year — came up with matching funds
y computers and graphing calculators.
to have every Montana high school outfit
e technology for the project by end of

st summer, 24 teachers gathered at the
of Montana in Missoula and wrote the
n — 18 modules or units — for the freshm
ath course. Another 32 teachers gathere
a State University in Bozeman for train
h the new math. And 10 teachers have ta
r sabbaticals to continue working on
all year.

ilot' phase

is year is actually the "pre-pilot" phas
ject, Lott said, to see if the curricu
Next year, the formal pilot for the n
will be conducted at eight schools, while
t program will continue as this year's n
s move on to 10th-grade modules.
is summer, 48 teachers are expecte
n writing curriculum, with at least 30 r
ained to teach it. Writers will finish the
urriculum, finish reviewing the ninth-g
lum and start on the 11th grade, Lott sa

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New math adding up to real life

'Pretty cool'
Students having fun with math program

By VIKKI McLAUGHLIN
Of the Gazette Staff

Gazette photo by Larry Mayer

Teacher Lisa Wood works on an experiment with students Lora Christiansen, Dave Weyler, Aaron "Bon Bon" Berklund and Scott Anderson.

While students in Algebra I at Billings Senior High are learning to solve equations like $2x+3=y$, Lisa Wood's SIMMS math students are learning about the characteristics of oil spills.

While freshmen algebra students learn to solve quadratic equations (containing variables to the 2nd power or higher), SIMMS students may be designing a miniature golf course as a test of their knowledge of reflections and angles.

And SIMMS students think learning about real-life problems instead of abstract formulas is great.

"It's a pretty cool math class," said David Layer, as he and his group watched drops of oil spread out on a piece of toilet paper. "I had trouble in my last class, but this makes it easier to learn."

"It's really fun, really hands-on," Erik Cooke said. "I like math, but this is totally different. It's a different problem each time, and you can apply it to real life."

Statewide program

The students in Wood's three freshman math classes, about 70 of them, are part of the pilot program for the Systemic Initiative for Montana Mathematics and Science, a multimillion-dollar statewide project to revamp the way high school mathematics is taught, so that students understand how it applies to their everyday lives.

Senior High is one of 12 schools acting as models for the project, teaching solely the SIMMS modules to the three classes for the whole year. Another 23 schools joined as participating schools, including West, Skyview and Central Catholic High School in Billings, teaching four of the 18 total modules. A total of 67 schools in the state received money for equipment for the project — seven MacIntosh IIsi computers, software and graphing calculators at Senior — and put up some of their own money to match.

Wood, who was one of 24 math teachers who spent the summer in Missoula writing the curriculum for the ninth-grade level of the project, said she's teaching integrated math to her students, which means that while students are learning algebra, they're also learning geometry, science and technology. Students are also working in groups, learning to work with other people.

In fact, on a recent school day, Wood's classroom looked more like a science lab than a math class as students used eye-droppers full of motor oil to squeeze drops of oil onto sheets of toilet paper, simulating a simplified oil spill. The experiment built a mathematical model of an oil spill, which would help them describe the event or predict something about it. Students also learned to determine the area of circles and irregularly shaped figures, about volume in containers and graphing the inverse variation of volume, demonstrating that as the height increases, the base decreases.

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The other thing the students like is that what they're learning applies to real life. In other classes, students so often ask, " 'What are we ever going to use this for?' " Wood said. "You never hear that here."

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(More on Math, Page 5C)

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Math project aims for relevance

By VIKKI McLAUGHLIN
Of the Gazette Staff

When all is said and done, the success of the SIMMS math project will be measured by how many students leaving a math class say, "When am I ever going to use this?"

"We don't want to hear that ever again," said Maurice Burke, co-director of the Systemic Initiative for Montana Mathematics and Science.

In a traditional math class, students are taught abstract equations, but they don't have a clue what the object is that the equation represents, Burke said. Students conclude that math is useless to them, and they stop taking the classes.

But math is "a powerful way of simplifying things," Burke said. By using it to organize information, to find patterns in such things as population growth or the odds of winning the lottery, and then experiencing the pattern — "that's fun, that's creative thinking and we like to do that," Burke said. "It gives us a sense of power." And then the equations mean something.

Giving students a clue

"The biggest indictment of our system is how students leave high school saying, 'I don't have a clue how to use it (math), so I won't take it in college,' " Burke said.

Burke, who is in Billings this weekend for a meeting of the nine members of the National Advisory Committee for the Montana project, visited Lisa Wood's SIMMS class at Senior High on Friday along with some of the committee members — national leaders in mathematics selected to help guide and advise local project directors.

One of those mathematicians, Dan Dolan, helped Burke and Johnny Lott, chairman of the math department at the University of Montana, write the original SIMMS proposal, and for 10 years was the math supervisor for the Montana Office of Public Instruction. Dolan is now associate director of mathematics at Wesleyan University in Middletown, Conn.

Sherry Fraser, director of a similar innovative, interactive math project at the University of California, Berkeley, also came to Billings for the committee's second conference on the SIMMS project, along with Clarence McMaster, assistant vice president of the Pensions and Savings Center, Metropolitan Life Insurance Co., in New York City.

Program under review

The committee is spending the weekend reviewing the progress of the SIMMS project so far, looking at how it's doing in the areas of professional development for teachers, curriculum and government interaction, and offering advice for improvement.

"I'm really excited about it," Fraser said. "This is the future."

Dolan said it was great in Wood's class to see students using computers, calculators, paper and pencil — all the tools to help them solve real problems.

"That's something we've got to get across to people, that they're not playing with these things, with that deck of cards," Dolan said. Technology helps the students solve the problems, but it does not take away their ability to think.

The SIMMS project has been in the works for about four years, and received $10 million in fun ing from the National Science Foundation in N vember 1991. The Montana Legislature added million for this year, the project's first year in t schools, with the intent of providing another $4 m lion over the next four years. So far, Johnny L said; the $2 million for the next two years is in t higher education budget, as well as in the gove nor's budget.

Schools that received funding from the proje — 67 this year — came up with matching funds help buy computers and graphing calculators. T goal is to have every Montana high school outfitt with the technology for the project by end of fi years.

Last summer, 24 teachers gathered at the U versity of Montana in Missoula and wrote the c riculum — 18 modules or units — for the freshm level math course. Another 32 teachers gathered Montana State University in Bozeman for train to teach the new math. And 10 teachers have tal leave or sabbaticals to continue working on project all year.

'Pre-pilot' phase

This year is actually the "pre-pilot" phase the project, Lott said, to see if the curricul works. Next year, the formal pilot for the ni grade will be conducted at eight schools, while pre-pilot program will continue as this year's nir graders move on to 10th-grade modules.

This summer, 48 teachers are expected work on writing curriculum, with at least 30 m being trained to teach it. Writers will finish the grade curriculum, finish reviewing the ninth-gr curriculum and start on the 11th grade, Lott sai

Baucus seeks ways to end 'holy wars' over environment

By NED MARTEL
States News Service

WASHINGTON — A new committee chairmanship will amplify Sen. Max Baucus' calls for balance in environmental regulation.

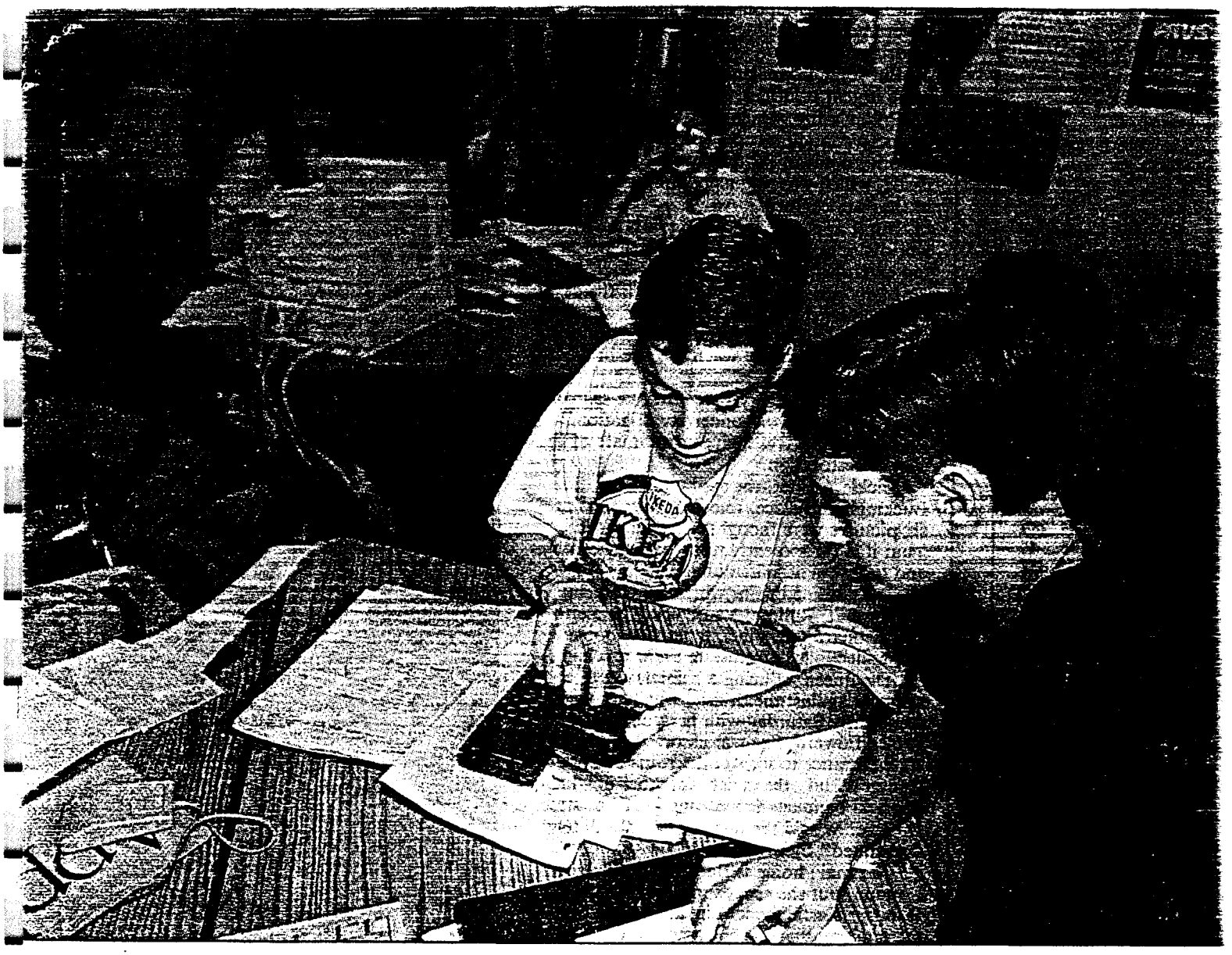
The Montana Democrat has vowed to "end the holy wars" waged between environmental activists and industry lobbyists who crusade before the Senate Environment and Public Works Committee Baucus now chairs.

Over two decades, panel members have engaged in regulatory battles over pollution prevention and species protection, fights that have usually ended in political bloodbath.

Trading emissions encourages technological leaps and links pollution more directly to corporate bottom lines, proponents say. But many who live near factories worry about increased health hazards and decreased property values when their industrial neighbors are permitted to increase pollution.

Baucus ties this model to his interest in coaxing corporations to spend more in research and development, possibly through tax incentives composed in the Finance Committee, where the senator also serves.

Baucus said his trip to the international Earth Summit in Brazil last summer strengthened his resolve to



KURT WILSON/Missou.

LOYOLA HIGH SCHOOL students Ryan Surmi, left, and Bryan Grasseschi use a calculator Friday morning to work out a math problem in a pilot program to test a new math curriculum.

Applied mathematics

This math class isn't just a numbers game

p1 - Missoulian 11-22-97

GARY JAHRIG
The Missoulian

"Mathematics is not a spectator sport," as the banner on the wall of the computer lab at Loyola Sacred Heart High School.

And as students in Mike Trudnowski's first-period class will attest, the Loyola teacher's math class is no place for spectators.

"Other math teachers just explain it and expect us to do it," said Kara Woodworth, a 14-year-old freshman. "But this is more hands-on. He relates the math to real-world situations and then we do it."

"Hands-on" is the key phrase when it comes to describing the curriculum used in the pilot class at Loyola. As one of 12 experimental classes being taught in the state this year, the Loyola class is a testing ground for a new curriculum being developed in Montana to make mathematics more appealing to high school students.

Funded by a $9.9 million grant from the National Science Foundation, the project – titled the Systematic Initiative for Montana Mathematics and Science (SIMMS) – is designed to integrate math with science concepts to give students a realistic glimpse of how mathematics is used in the real world. The curriculum for the five-year project, now in its second year, is being written by a team of Montana math teachers with assistance from faculty at the

(See **MATH**, Page A-10)

Math

(continued)

University of Montana and Montana State University.

Mignon Waterman, a state senator from Helena who is handling public relations for the project, said the schools participating in the pilot program were selected on the basis of diversity.

"We have a crosscut of schools — large and small, minority and private," she said.

Along with Loyola, other western Montana high schools participating in the pilot program are in St. Ignatius and Kalispell. Loyola is the only private school taking part.

Waterman said the pilot classes will be closely monitored this year, with twice as many schools scheduled to become involved next year. The program may also be get a trial next year in the Seattle school system to find out how it works in a large, urban market, she said.

Trudnowski, who spent the summer at UM preparing to teach the course, said the goal of the project is to have every school in Montana using the curriculum by the year 2000.

"We're developing a curriculum to prepare all of our students coming out of high school — not just the kids who are going on to college," said Trudnowski. "Our objective is to have every student take four years of integrated math in high school."

At 8:10 a.m. on Friday, 21 students file into the computer lab located in the southwest corner of the third floor of Loyola Sacred Heart. The class, which meets five times a week, normally has 24 students, but on this cool November morning, two members are absent and one shuffles in about 15 minutes late.

The majority of the students in the room are Loyola freshmen, but the class also has five eighth-graders from Missoula's St. Joseph School.

"We found out we had five positions to fill so we opened it up to some middle school students," Trudnowski said.

Trudnowski is quick to point out that while many of the students in the class perform well in math, it is not an honors program.

The students sit in groups of three or four at six tables, each equipped with a Macintosh computer. Every student has a Texas Instrument graphing calculator supplied by the school, which Trudnowski said is an essential component of the new curriculum.

"It gives the student a technological tool to take home with them," Trudnowski said. "The kids are going to use a calculator in the real world, so they must learn how to use it in class too."

The first order of business Friday is to go over the previous evening's homework assignments. Trudnowski quickly jars the students out of their early morning slumber, calling on members of the class to not only supply answers, but to relate them to real-life situations.

"How much is 1.2564 liters?" he asks one student. "Could you drink that much Coke in one sitting?"

The homework assignment stems from a lesson about oil spills, one of 18 "modules" in the curriculum that teach students a mixture of algebra, geometry, probability, statistics and other mathematical concepts. Each unit is designed for students to identify a real-life problem and determine the best method of solving the problem, using various math concepts.

For the oil-spill module, Trudnowski had his students create their own spills using toilet paper and used motor oil. After letting their experiments sit for 24 hours, the students measured the spills and graphed the results on their calculators. Instead of learning about area and linear relations through a textbook, the Loyola students covered the same subject material through a hands-on experiment.

"All of a sudden, the real world is right there on their desk," Trudnowski said.

The rest of the class period Friday is spent going over computer-produced graphs and linear equations. As Trudnowski writes down data on the white board at the front of the classroom, he constantly prompts and prods students to explain how they came up with their answers.

As the 9:05 a.m. bell signal the end of the Trudnowski reels off the w homework assignment, urg students to continue their over the next two days.

"Don't be a couch pot weekend," he calls out as dents file out the door.

While the program is its infancy stage, early from Loyola students show already had an effect.

"I had a really hard tin algebra last year," said Turley, a 14-year-old fre "But this year I find it k easy.

"Instead of handing book and working out pro you get to do different thing

Turley also said he lik idea of working in groups, Trudnowski said occurs ab percent of the time in this cl

"It's nice to be able to w groups because you can hel other out," Turley said.

Kara Woodworth sai appreciated the relationsh real-life situations that emphasized in the class.

"If we can see it and se it is and how it grows, to m helps me understand," worth said. "I enjoy mat fun, but it's more fun whe have a teacher who can exp in real terms."

Damon Gordon, a 15-ye freshman, said his interest in has increased since en Trudnowski's experimental c

"This is better becaus learn more than just doing and division," Gordon sai kind of makes it more enj because we get to work with lators and computers. It's funner to do math."

As part of the stu grades, Trudnowski does dai weekly assessments to gauge class member's improve While the class is only 3 m old, he too believes it has b success.

"This early in the year, i define success as excitemen involvement, then, yes, it is cess."

EXHIBIT
DATE 2-15-93
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THE SIMM PROJECT

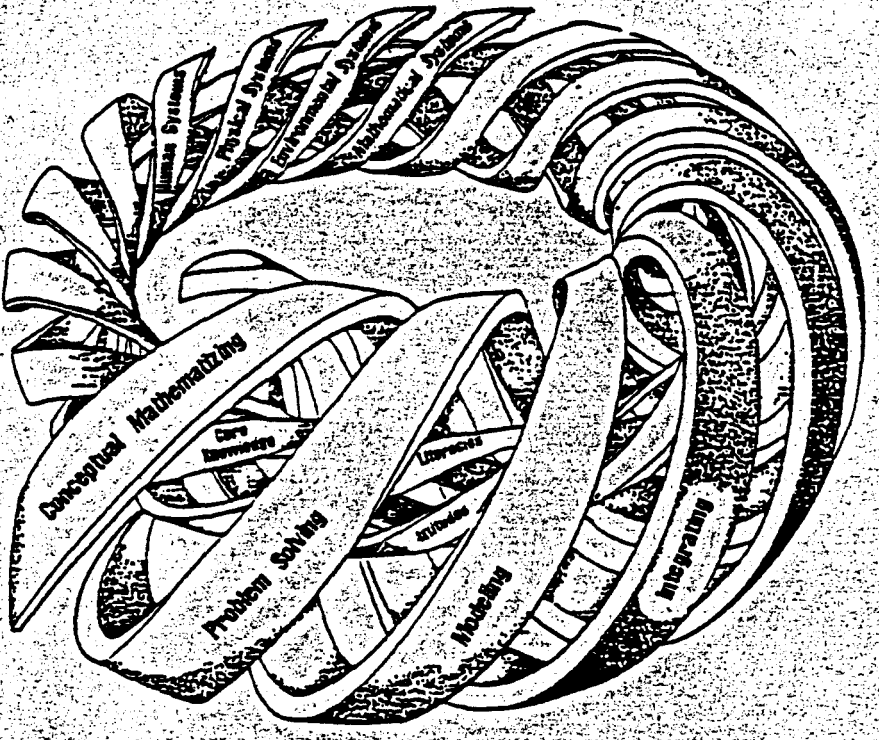

Illustration based on M.C. Escher's work - SPIRALS - 1953
With Permission of the M.C. Escher Foundation - Baarn - Holland

OIL: BLACK GOLD

A Module Prepared For
Montana Council of Teachers of Mathematics
Systemic Initiative for Montana Mathematics
A National Science Foundation Grant

FOR FIELD TEST USE ONLY

EXHIBIT 4
DATE 2-15-93
SB

February 15, 1993

Exhibit 4, "Oil: Black Gold", is 26 pages long. The original is stored at the Historical Society at 225 North Roberts Street, Helena, MT 59620-1201. The phone number is 444-2694.

"Goals for student performance are shifting from a narrow focus on routine skills to development of broad-based mathematical power." (p. 5)

All of today's students must be able to:

- Perform mental calculations and estimates with proficience.
- Decide when an exact answer is needed and when an estimate will serve the purpose.
- Know which mathematical methods are appropriate in particular contexts.
- Use a calculator correctly, confidently, and appropriately.
- Estimate orders of magnitude to confirm mental or calculator results.
- Make decisions based upon the collection, representation, and interpretation of real data.
- Use tables, graphs, spreadsheets, and statistical techniques to organize, interpret, and present numerical information.
- Judge the validity of mathematical and technical information presented by the media and others.
- Use computer software for mathematical tasks.
- Formulate specific questions from vaguely defined problems.
- Select effective problem-solving strategies. (p. 6)

Mathematical Sciences Education Board, National Research Council. *Counting on You Actions Supporting Mathematics Teaching Methods.* Washington, D. C.: National Academy Press, 1991.

EXHIBIT 5
DATE 2-10-93

SIMMS OBJECTIVES

1. Redesign the 9 - 12 mathematics curriculum using an integrated interdisciplinary approach for all students.

2. Develop and publish curriculum and assessment materials for grades 9 - 16.

3. Incorporate the use of technology in all facets and at all levels of mathematics education.

4. Develop an action plan to increase the participation of females and Native Americans in mathematics and science and to increase the number of female and Native American teachers in these areas.

5. Establish new certification and recertification standards for teachers.

6. Redesign teacher preparation programs using an integrated interdisciplinary approach.

7. Develop an extensive inservice program in mathematics grades 9 - 16 to prepare teachers for implementation of integrated mathematics programs.

8. Develop the support structure for legislative action, public information, and general education of the populace necessary for effective implementation of new programs.

EXHIBIT 6
DATE 2-15-93
SB

All Students

students who have been denied access in any way to educational opportunities as well as those who have not.

students who are African American, Hispanic, American Indian, and other minorities as well as those who are considered to be a part of the majority.

students who are female as well as those who are male; and

students who have not been successful in school and in mathematics as well as those who have been successful.

EXHIBIT 7
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EXHIBIT 8
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SB

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INDEX

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EXHIBIT 8
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SB

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IMPACT OF TECHNOLOGY ON THE MATHEMATICS CURRICULUM

- Some mathematics becomes *more important* because technology *requires* it
- Some mathematics becomes *less important* because technology *replaces* it
- Some mathematics becomes *possible* because technology *allows* it

EXHIBIT 9
DATE 2-15-93
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Overall Goal of SIMMS Project

Help students learn to make mathematically informed decisions!

EXHIBIT 10
DATE 2-15-93
SB

NATIONAL SCIENCE FOUNDATION
1800 G STREET, N.W.
WASHINGTON, D.C. 20550

Statewide Systemic Initiatives

February 5, 1993

Dr. Johnny Lott
Department of Mathematical Sciences
University of Montana
Missoula, MT 59812

Dear Dr. Lott,

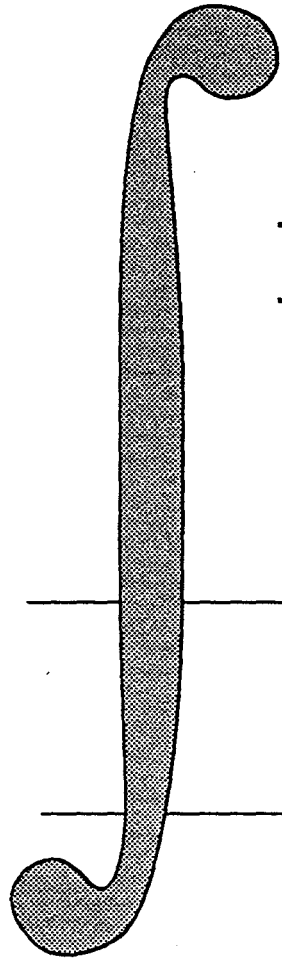
It has come to my attention that there may be some tough decisions that the Montana Legislature will make in the coming budget process. As the Program Officer responsible for Montana's SSI, I want you to know that any reduction in the state's matching fund commitment could have repercussions for the continued funding from the National Science Foundation. In order to understand the legal consequences of the state not meeting its obligations, I suggest that you contact Ms. Dionie Henry (202/357-9626) of the Foundation's Division of Grants and Contracts to determine the specific aspects of Montana's commitment as described in the original and renewed cooperative agreement.

The SSI staff is here to aid you in resolving any programmatic issues regarding Montana's SSI award.

Sincerely,

Michael W. Oliver
Program Officer
Statewide Systemic Initiatives

EXHIBIT 11
DATE 2-15-93



INTEGRATED MATHEMATICS

Definitions
Issues
Implications

Executive Summary

EXHIBIT 12
DATE 2-15-93
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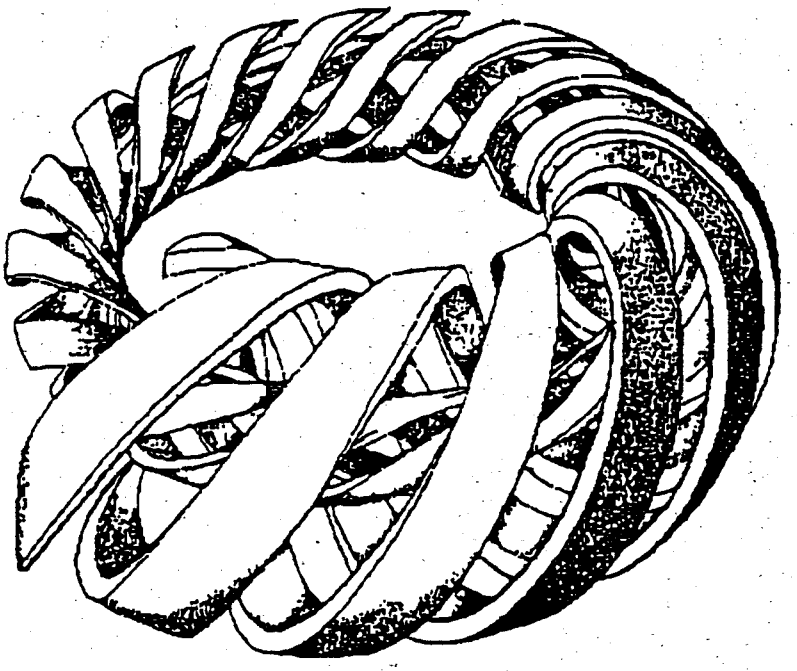
Montana Council of Teachers of Mathematics

February 15, 1993

Exhibit 12, "Integrated Mathematics", is 11 pages long. The original is stored at the Historical Society at 225 North Roberts Street, Helena, MT 59620-1201. The phone number is 444-2694.

THE SIMMS PROJECT



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Prepared for
Montana Council of Teachers of Mathematics
Systemic Initiative for Montana Mathematics and Science
A National Science Foundation Grant
January 1993

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DATE 2-15-93
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DRAFT

February 15, 1993

Exhibit 13, "The SIMMS Project", is 34 pages long. The original is stored at the Historical Society at 225 North Roberts Street, Helena, MT 59620-1201. The phone number is 444-2694.

MONTANA STATE UNIVERSITY
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February 14, 1993

SUPPORT FOR ENGINEERING RESEARCH CENTER (ERC)

"It is critical to the economic development of Montana that we vigorously pursue a productive niche in biotechnology emphasizing our traditional strengths and interests as well as developing new areas." Montana Science and Technology Action Agenda, 10/92

The National Science Foundation (NSF) has established 18 ERC's in the U.S.; 3 in the area of Biotechnology -- at Duke University, MIT, and MSU. (See attachment 1.) In describing the MSU ERC, NSF states, "Compelling national needs call for fundamental research in industrially relevant environmental biotechnologies." (Attachment 2. is NSF's description of the MSU ERC.)

ERC's are structured to be partnerships with industries who play a key role in providing support and direction for relevant research programs needed by the industries. Our industrial partners number 20, mainly Fortune 500 Companies such as Conoco, British Petroleum, Aramco, Calgon, Dow, Exxon, Procter and Gamble, Unilever.

NSF is providing $7.5 million over 5 years, with industry and other sources, mainly other grants, providing another approximately $7.5 million. In order to obtain this prestigious national center, NSF requires that the state provide a match. In this case, Governor Stephens and his Budget Director, Dave Darby, committed $1 million, $200,000 per year for 5 years. (See attachments 3 and 4.) The first $600,000 was provided by the 1991 Legislature, so this is a request for the last $400,000 from this 1993 Legislature. **FOR A STATE INVESTMENT OF $1 MILLION IT GETS A PROGRAM OF $16 MILLION, PLUS ALL OF THE ECONOMIC AND TECHNOLOGY TRANSFER SPIN-OFFS. The average business in MT has annual payroll of $150,000, so ERC is equivalent to 13 to 14 businesses.**

AREAS OF TECHNOLOGY DEVELOPMENT - Examples

* Bioremediation of hazardous waste or toxic spills
* Souring of oil formations
* Microbial growth in drinking water supply systems
* Tooth decay
* Biocorrosion
* Infections due to artificial devices in humans

EXHIBIT 14A
DATE 2-15-93
SB

TESTIMONY by Robert J. Swenson, Vice President for Research

EXHIBIT 14B
DATE 2-15-93

Engineering Research Centers: A Partnership for Competitiveness

In 1985, the National Science Foundation's Directorate for Engineering established the Engineering Research Centers (ERC) Program in accordance with a model envisioned by the National Academy of Engineering.

The need for the ERC program arose from the fact that despite America's preeminence in science, our competitive position in the international marketplace has been increasingly eroded. Besides the various economic and managerial factors, part of this competitiveness problem can be attributed to the gradual loss of U.S. industrial prowess in turning research discoveries into high quality, competitive products.

Many practitioners and leaders have come to the realization that while American academic engineering has made great strides in basing modern engineering on advanced scientific knowledge and the latest laboratory and computational tools, it has not placed sufficient emphasis on the design of manufacturing processes and products to keep pace with increasingly sophisticated consumer demands around the world.

In addition, cross-disciplinary research focused on technological advancement from an engineering systems perspective is needed to better prepare engineering graduates with the diversity and quality of education needed by U.S. industry.

The ERC program was designed to address these issues. The goal of this program is to develop advances in the knowledge and technical bases in areas enhancing the international competitiveness of U.S. industry by sponsoring major cross-disciplinary research and education centers at universities.

Each ERC is established as a three-way partnership involving academia, industry, and the National Science Foundation (in some cases with the participation of state, local, and/or other Federal government agencies). Annual funding for a Center ranges from $2.5 to $8.0 million, with the NSF's contribution ranging from $1.8 to $3.3 million per year.

The objective of the program is to bring engineering and scientific disciplines together to address fundamental research issues crucial to the next generation of technological advances from an engineering systems perspective. It also aims to educate a new generation of engineering students in a cross-disciplinary team approach to problem solving. The program requires active participation and long-term commitments from industry and other user organizations.

The major technological areas upon which the ERCs focus are—

Design and Manufacturing

Materials Processing for Manufacturing

Optoelectronics/Microelectronics/ Telecommunications

Biotechnology/Bioengineering

Energy and Resource Recovery

Infrastructure

Design and Manufacturing

Engineering Design
Carnegie Mellon University

Systems Research
University of Maryland and Harvard University

Computational Field Simulation
Mississippi State University

Net Shape Manufacturing
Ohio State University

Intelligent Manufacturing Systems
Purdue University

Materials Processing for Manufacturing

Interfacial Engineering
University of Minnesota

Advanced Electronic Materials Processing
North Carolina State University and other North Carolina Institutions

Plasma-Aided Manufacturing
University of Wisconsin-Madison and University of Minnesota

While the ERCs differ from one another, each must possess these key features:

- A clear and coherent vision guiding high quality fundamental engineering research in areas critical to U.S. economic competitiveness.

- A strategic plan to integrate the research and educational programs of the Center and focus them on knowledge and technological advances that would not occur with separate individual research grants.

- Active collaboration between appropriate engineering and scientific disciplines with a systems view.

- A strong educational component involving a significant number of engineering students at both the graduate and undergraduate levels emphasizing the cross-disciplinary, integrated view of the technology from research to product. A commitment to curriculum and course content innovations based on the unique features of the ERC.

- Participation of practicing engineers and scientists to help focus activities on the needs of industry and to enhance the education of students in broad issues of engineering such as design, manufacturability, reliability, and other economic factors. To assure such involvement, substantial commitments from participating companies, e.g., money, equipment, and people, are essential. Other Federal, state, and local agencies and laboratories involved in engineering practices also may be partners or participants.

- Methods for the timely transfer of knowledge and technological advances to industrial and other users.

- Special experimental capabilities and engineering testbeds that the ERC provides because of high instrumentation costs, need for skilled technicians, or other maintenance and/or operating requirements not available through single investigator projects.

- Outreach to involve faculty and students from other schools in the region/nation in the programs of the ERC as appropriate.

- Substantial commitments from the university in the form of financial and other support, integration of the ERC with the participating departments and programs, and tenure practices which support involvement in the ERC.

Optoelectronics/Microelectronics/ Telecommunications

Data Storage
Carnegie Mellon University

Optoelectronic Computing Systems
University of Colorado and
Colorado State University

Telecommunications
Columbia University

Compound Semiconductor Microelectronics
University of Illinois at Urbana-Champaign

Biotechnology/Bioengineering

Emerging Cardiovascular Technologies
Duke University

Biotechnology Process Engineering
Massachusetts Institute of Technology

Interfacial Microbial Process Engineering
Montana State University

Energy and Resource Recovery

Advanced Combustion Engineering
Brigham Young University and the University of Utah

Offshore Technology
Texas A&M University and the University of Texas at Austin

Infrastructure

Large Structural Systems
Lehigh University

EXHIBIT 14C
DATE 2-15-93
SB

CENTER FOR INTERFACIAL MICROBIAL PROCESS ENGINEERING

Center for Interfacial Microbial Process Engineering

Montana State University with Idaho National Engineering Laboratory

A National Science Foundation Cross-disciplinary Engineering Research Center since 1990

Compelling national needs call for fundamental research in industrially relevant environmental biotechnologies

Interfacial microbial processes account for more than 99% of the microbial activity in—
- Rivers and streams
- Groundwater and soil
- Waste water treatment processes
- Industrial operating equipment, such as cooling towers, pipelines, and many other essential systems.

Clearly, these processes adversely affect the U.S. economy, its environment, and its industrial competitiveness. They even adversely impact human health. However, they also provide unique opportunities in areas like bioremediation of hazardous waste and biohydrometallurgy.

Research

Working with interfacial microbial processes, the Center—
- Conducts basic and applied research needed to resolve environmental problems and strengthen U.S. competitiveness
- Performs cross-disciplinary, microscale research to advance the science and technology of interfacial microbial processes
- Pursues cross-disciplinary, proof-of-concept research to provide validated knowledge and technology ready for testbeds on site or in industry.
- Develops instrumentation and technology for process control of industrial systems and environmental processes
- Fosters cooperative research with industrial partners and with universities and research organizations around the world.

Research is organized around five fundamental thrust areas:
- Transport and Interfacial Transfer Phenomena
- Physiological Ecology and Genetic Exchange
- Extracellular Chemical and Electrochemical Phenomena
- Instrumentation and Process Control
- Modeling and Information Management.

Education

The Center's educational goal is to establish a comprehensive program that significantly impacts education in environmental biotechnology nationwide.

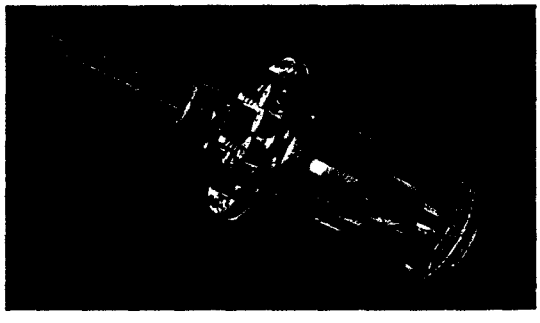
For its full-time graduate and undergraduate studies, the Center—
- Recruits qualified students for its unique course of studies which takes a systems approach, integrating microbiology and chemistry with process engineering
- Provides an environment for skill development in which students participate in cross-disciplinary team research focused on finding innovative solutions to industrial problems
- Affords opportunities and strong support for refinement of skills in oral and written communication.

During its first year and one-half, the Center—
- Offered two cross-disciplinary courses (Microbial Process Analysis and Environmental Engineering Investigations)
- Sponsored an on-going series of seminars by researchers prominent in the field
- Conducted a weekly student seminar series where students present their research and develop cross-disciplinary communication skills
- Hosted two summer undergraduate research programs, with students from around the country
- Offered course work at one of the Center's Industrial Associate facilities (INEL)
- Hosted several international visiting professors, including Dr. Oskar Wanner of the Swiss Federal Institute for Water Resources and Water Pollution Control; Dr. W. Allan Hamilton, University of Aberdeen, Scotland; Dr. J. Gijs Kuenen, Delft University, the Netherlands; Dr. Mitsuru Takasaki, Senshu University, Japan; and Dr. Per Nielson, University of Aalborg, Denmark.

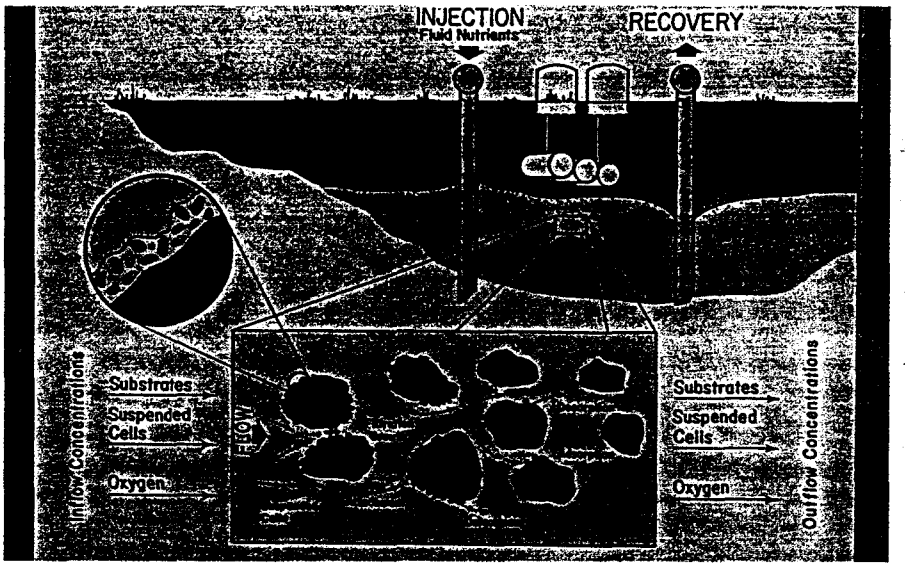
In addition, 34 graduate students from 10 different disciplines have worked on research in the Center; 39 undergraduates have also participated; 25 of the students are women. Two Native American high school students also worked in the Center during the summer.

Industrial Collaboration/ Technology Transfer

Industrial task groups assist the Center in strategic planning. They also help set research priorities, review projects, and identify needed technology that could be advanced through collaboration with the Center. This process ensures that the Center works with industry in key problem areas such as—
- Investigating methods to control microbial souring



The Center-developed Rototorque, a compact biofilm reactor with controlled fluid shear stress, is used in the Center's *Alpha* Lab and in numerous industrial labs worldwide.



The Center's micro/meso/macroscale research approach is demonstrated in this illustration of a contaminated groundwater aquifer. The macroscale system is a plug-flow reactor. At the mesocale, the influence of geometry and fluid dynamics impacts biofilm cell accumulation and activity in the aquifer. Interestingly, at the microscale, activity is similar regardless of whether the system is a cooling tower, a paper machine, a wastewater treatment plant, a catastrophic oil spill, or the human body.

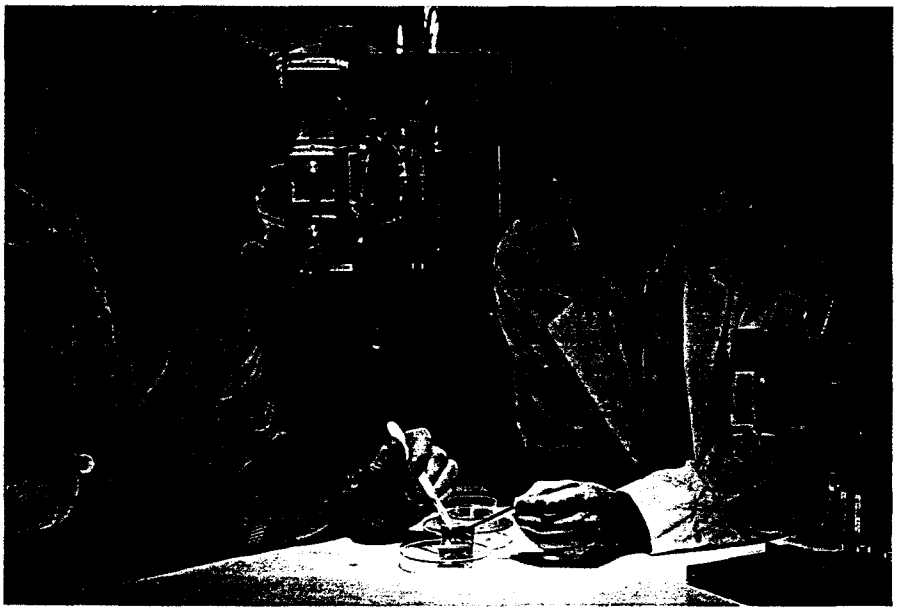
of oil formations (collaboration with five major oil companies)

- Constructing a computerized database for developing strategies to limit microbial growth in drinking water supply systems (collaboration with over 30 U.S. water utilities).

The Center's new *Alpha* Test-Bed Laboratory provides members of industry with hands-on experience and demonstrations in applying Center developed technology such as monitoring bio-film formation in a pilot scale heat exchanger.

Through the Industrial Associates program, which has grown to 19 major corporations and organizations, industry contributes directly to Center research. Representatives from a variety of industries have also visited the Center to learn Center-developed methods and techniques. In addition, the Center has formed a working partnership with the Idaho National Engineering Laboratory (INEL) which has included personnel exchanges and active research collaboration.

Industry is also a major contributor to the Center's Research Initiative program by focusing fundamental research to address specific industrial problems or concerns. The Center currently has active Research Initiatives in Biofouling (including a major research program for the drinking water industry); Biocorrosion; Bioremediation of Water and Soil Contaminated by Petroleum Hydrocarbons; and Microbially Induced Souring of Oil-Bearing Formations. Initiatives in health/oral hygiene and biohydrometallurgy are under consideration.



Microbiologists Dr. Gill Geesey and Dr. Phil Bremer examine a sample of corroded copper pipe.

Kurt Schilling, Unilever, (left) learns to apply the Center's image analysis system to the problems of oral hygiene.

Facilities

The MSU College of Engineering has provided 10,000 square feet of contiguous office and laboratory space for use by the Center. An additional 1,600 square feet of nearby lab space houses the Center's *Alpha* Lab where Center methods, techniques, and technologies are tested in an industrial-like setting. The Center's highly specialized facilities include a complete microbiology laboratory, an analytical chemistry lab, a comprehensive image analysis facility, and a microsensor facility. A confocal microscope is expected to be in operation in early 1992.

The Center continues to build a facility and equipment pool which allows scientists and engineers to observe, record, and quantify microbial phenomena at interfaces. The equipment pool has already become a national resource, used by researchers from a variety of industries, universities, and research organizations to advance the nation's understanding of interfacial microbial process engineering.

Center Headquarters

Center for Interfacial
Microbial Process Engineering
409 Cobleigh Hall
College of Engineering
Montana State University
Bozeman, MT 59717
(406) 994-4770
FAX: (406) 994-6098

Interim Center Director: John Sears

Director of Administration: Bill Harn

EXHIBIT 14D
DATE 2-15-93
SB

State of Montana
Office of the Governor
Helena, Montana 59620
406-444-3111

STAN STEPHENS
GOVERNOR

MAY 14 1990

May 10, 1990

Dr. John W. Jutila
Vice President for Research
Montana State University
Bozeman, Montana 59717

Dr. Jutila:

I am pleased to confirm the State's commitment to meeting our pledged $1,000,000 support over the next five years for the $7,500,000 grant awarded to MSU by the National Science Foundation for the new engineering research center. My staff and I will be conferring with you and University System financial officers to identify appropriate sources of funding.

Sincerely,

STAN STEPHENS
Governor

cc: Dr. Carrol Krause, Commissioner of Higher Education
Dr. William Tietz, President, Montana State University

EXHIBIT 14E
DATE 2-15-93
SB

OFFICE OF THE GOVERNOR
BUDGET AND PROGRAM PLANNING

STAN STEPHENS, GOVERNOR — STATE CAPITOL

STATE OF MONTANA

(406) 444-3616 — HELENA, MONTANA 59620

JUN 1 1990

John W. Jutila,
Vice President for Research
Montana State University
Bozeman, Montana 59717

May 30, 1990

Dear Dr. Jutila: John

In accordance with Governor Stephens' commitment to supplement the National Science Foundation Grant to MSU for establishment of an engineering research center, $1,000,000 in state financial support will be provided over the next five years. The FY91 source of funds has been specifically identified as the educational trust fund monies in accounting entity 02467, agency 5102, which were reverted to the general fund. The Governor's office will introduce legislation in January to ensure earmarking of $200,000 of this reversion for the NSF project during state fiscal year 1991.

The $800,000 balance of state support with proposed funding of $200,000 per annum will be included in the Executive Budget Recommendations for the 1993 and 1995 biennia. I have every expectation that appropriation authority from the legislature will be readily forthcoming for both the initial and subsequent matching funds.

Very truly yours,

W. David Darby, Director
Office of Budget and Program Planning

cc: Dr. Carrol Krause, Commissioner of Higher Education
Dr. William Tietz, President, Montana State University

TABLE A
Comparison of Subcommittee Action to LFA Current Level and 1993 Biennium
Initial Reduction Target
General Fund, Only

Unit	1993 Biennium	LFA 1995 Biennium	Subcommittee Action As Of 02/13/93	Reductions From 1993 Biennium	Reductions from LFA Current Level	Remaining Reduction
			--- Six University Units ---			
MSU	71,320,228	70,905,179	62,382,755	(8,937,473)	(8,522,424)	
UM	56,350,453	59,089,286	51,330,535	(5,019,918)	(7,758,751)	
EMC	21,226,621	21,388,886	18,843,825	(2,382,796)	(2,545,061)	
NMC	12,199,521	11,871,831	10,510,734	(1,688,787)	(1,361,097)	
WMCUM	7,009,989	7,207,526	6,392,594	(617,395)	(814,932)	
MCMST	14,686,488	16,182,912	14,446,229	(240,259)	(1,736,683)	
Total Six Units	182,793,300	186,645,620	163,906,672	(18,886,628)	(22,738,948)	
			--- Vocational Technical Centers ---			
Billings	2,476,634	2,300,841	2,408,887	(67,747)	108,046	
Butte	2,925,601	2,235,666	2,413,030	(512,571)	177,364	
Great Falls	3,213,251	2,871,311	3,374,459	161,208	503,148	
Helena	3,999,019	3,767,182	3,820,378	(178,641)	53,196	
Missoula	4,085,416	3,964,016	4,036,989	(48,427)	72,973	
Total Vo-Techs	16,699,921	15,139,016	16,053,743	(646,178)	914,727	
CHE						
Administration	2,236,839	2,094,816	1,957,385	(279,454)	(137,431)	
Student Assistance	9,529,736	10,365,618	10,122,909	593,173	(242,709)	
Community Colleges	7,565,076	8,802,910	8,434,154	869,078	(368,756)	
Carl Perkins Admin	167,333	154,025	164,293	(3,040)	10,268	
Board of Regents	64,469	67,545	67,545	3,076	0	
Bond Payments	1,404,408	1,260,843	1,260,868	(143,540)	25	
Vo-Tech Admin	196,622	208,869	200,780	4,158	(8,089)	
AES	15,170,666	15,869,754	14,292,127	(878,539)	(1,577,627)	
CES	5,847,494	5,555,127	5,575,016	(272,478)	19,889	
FCES	1,416,555	1,398,825	1,405,543	(11,012)	6,718	
MINES	2,613,671	2,705,110	2,594,904	(18,767)	(110,206)	
FSTS	479,688	496,661	482,319	2,631	(14,342)	
TOTAL HIGHER ED	246,185,778	250,764,739	226,518,258	(19,667,520)	(24,246,481)	
OPI*	91,094,589	90,428,764	90,973,597	(120,992)	544,833	
Board of Pub Ed	209,980	229,268	222,199	12,219	(7,069)	
MSDB	5,504,347	5,626,423	4,958,869	(545,478)	(667,554)	
TOTAL EDUCATION	342,994,694	347,049,194	322,672,923	(20,321,771)	(24,376,271)	
Additonal Target	(20,328,073)					
Supplementals Approved/Pending	(407,814)					
TOTAL ED SUBCOMMITTEE	322,258,807	347,049,194	322,672,923	414,116	(24,376,271)	414,116

*Subcommittee action does not reflect a reduction of administrative expenses of $358,337 and impact aid of $9,200, contingent upon the passage of other bills. Total remaining reduction with the incorporation of these reductions is $577,214.

EXHIBIT 15
DATE 2-15-93

HOUSE OF REPRESENTATIVES
VISITOR REGISTER

EDUCATION SUBCOMMITTEE DATE

DEPARTMENT(S) DIVISION 2-15-93

PLEASE PRINT **PLEASE PRINT**

NAME	REPRESENTING	
Johnny W. Lott	SIMMS Project	
Bob Swenson	ERC Project	
John Sears	ERC Project	
Earl Ivey	OPD	

PLEASE LEAVE PREPARED TESTIMONY WITH SECRETARY. WITNESS STATEMENT FORMS ARE AVAILABLE IF YOU CARE TO SUBMIT WRITTEN TESTIMONY.