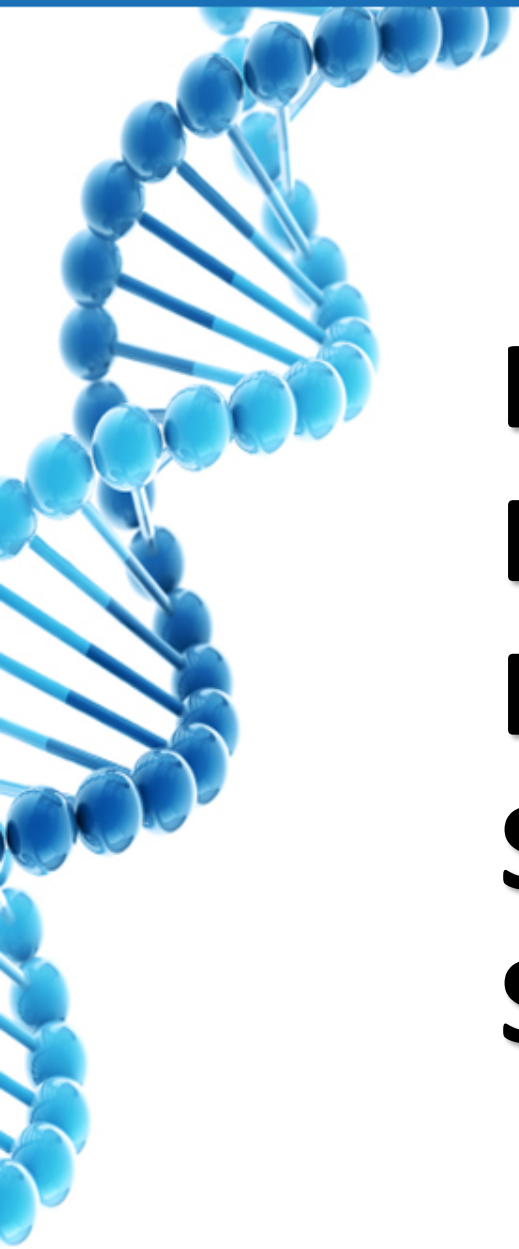

New Mexico Association of Student Affairs Professionals
14th Annual Symposium, October 17, 2013

LEARNING FROM EACH OTHER: Brainstorming STEM Student Achievement Strategies

SHORT VERSION

UNM STEM GATEWAY

STEM Gateway Contact Information…

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University of New Mexico
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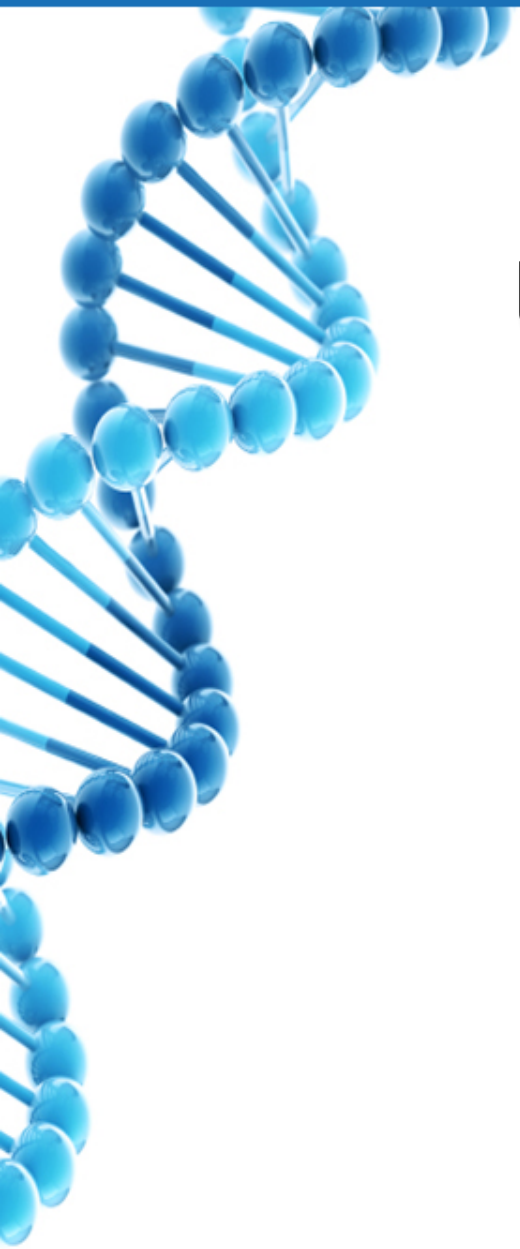
http://unmstemgateway.blogspot.com/
RESEARCH Tab, or IMPACT Tab > Presentations
(LONG VERSION includes additional data and analysis)

PART 1:
UNM RESEARCH INTO STEM STUDENT ACHIEVEMENT



THE UNIVERSITY of NEW MEXICO

GATEWAY

MISSION OF STEM GATEWAY:

- Improve STEM instruction and student support at the University of New Mexico
- Improve STEM graduation rates among Hispanic and/or low-income students

GRANT OVERVIEW:

- Funded by US Depart of Education Hispanic Serving Institution STEM Program
- $3.8 million over five years
- October 2011 through September 2016

Definition of STEM

For the purpose of this study, STEM (Science, Technology, Engineering and Mathematics) degrees are defined narrowly as those bachelor's degrees within the following disciplines: astrophysics, biology, biochemistry, chemistry, computer science, earth & planetary sciences, engineering (all majors), environmental science, mathematics, physics, and statistics.

STOP, SWITCH OR STAY…

Research Questions

Explores STEM degree completion patterns at UNM through two primary lenses:

Degree outcomes. How do undergraduate students who graduate with STEM degrees differ from those who switch majors out of STEM, and from those who stop attending UNM prior to completing their degrees?

Course outcomes. How do undergraduate STEM students perform in the core math & science gateway courses that lead into their STEM degrees?

POPULATION DESCRIPTION / DEFINITIONS

For both of these lenses, we studied:

- 1503 **first-time full-time freshmen** students from the falls of 2005, 2006 and 2007 …
- **who initially stated they were interested in STEM degrees …**
- **representing 16.6% of the freshman population during these three fall semesters**.

These students indicated an interest in STEM majors when completing their admissions applications, or when visiting with academic advisors during their first semesters.

DEGREE OUTCOMES LENS

Student Outcomes

This portion of the study seeks to identify patterns regarding four subsets of STEM students from the 2005, 2006 and 2007 cohorts as described above:

- **ENROLLED:** Students who are still enrolled in courses at UNM, and who indicate that as of Fall 2012 they were still working towards STEM degrees.
- **GRADUATED:** Students who graduated with STEM degrees prior to the Fall 2012 semester.
- **SHIFTED:** Students who switched out of STEM areas, but who continued taking courses at UNM. These students may or may not have graduated with degrees in non-STEM disciplines.
- **STOPPED:** Students who stopped attending courses at UNM.

Table 1. Overview of Population	
Total Number of Students	1503
Number of students who changed majors out of STEM (SHIFTED)	639 (42.5%)
Number of students who graduated with STEM degrees (GRADUATED)	**334 (22.2%)**
Number of students who stopped attending UNM (STOPPED)	444 (29.6%)
Number of students still enrolled at UNM (ENROLLED)	86 (5.7%)

SELECTED FINDINGS
DEGREE OUTCOMES LENS

SUBPOPULATIONS

Ethnicities in Students Opting to Go Into STEM

	THIS POPULATION OF STEM STUDENTS	THE GENERAL POPULATION OF FRESHMEN ONLY FROM UNM FACTBOOKS (Falls 05,06,07 combined)
Percent American Indian	6.4%	5.27%
Percent Asian/Pacific Islander/Native Hawaiian	5.5%	4.22%
Percent Black/African American	2.3%	3.29%
Percent Hispanic	**35.5%**	**37.6%**
Percent White, Non-Hispanic	46.2%	45.45%
Percent Male	62.3%	*Not available* **44.4% of general population of all UNM Main campus students**
Percent Female	**37.7%**	*Not available* **55.6% of general population of all UNM Main campus students**

SUBPOPULATIONS

Ethnicities in Degree Outcomes

American Indian STEM students are 2.55 times as likely to stop attending UNM (p<.001) and are 0.30 times as likely to graduate with STEM degrees (p<.001) as non-American Indian students.

	ODDS RATIO	P-VALUE
STOPPED	2.55	< .001
SHIFTED	0.80	.338
GRADUATED	0.30	< .001

SUBPOPULATIONS

Ethnicities in Degree Outcomes

Hispanic STEM students are .65 times as likely to graduate with STEM degrees than non-Hispanic students (p=.001).

	ODDS RATIO	P-VALUE
STOPPED	1.17	.175
SHIFTED	1.03	.827
GRADUATED	0.65	.001

SUBPOPULATIONS

Ethnicities in Degree Outcomes

Black/African American STEM students are 1.96 times as likely to switch majors out of STEM than non-African American students (p=.001).

	ODDS RATIO	P-VALUE
STOPPED	0.61	.341
SHIFTED	1.96	.055
GRADUATED	0.91	> .999

SUBPOPULATIONS

SES in Degree Outcomes

Pell-Eligible STEM students are 1.43 times as likely to stop attending UNM (p=.007) and are .46 times as likely to graduate (p<.001) than non-Pell-eligible students.

First Generation STEM students are 1.62 times as likely to stop attending UNM (p<.001) and are .42 times as likely to graduate (p<.001) than non-First Generation students.

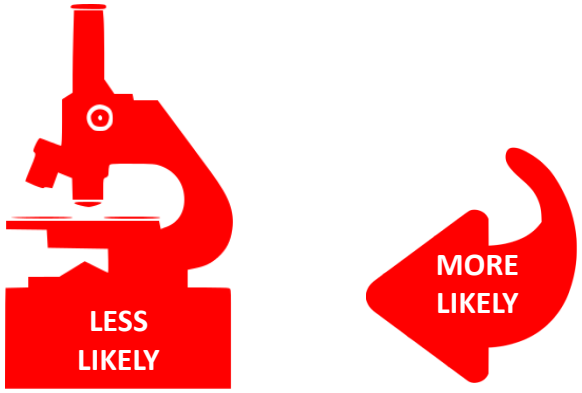
PELL ELIGIBLE	ODDS RATIO	P-VALUE
STOPPED	1.43	.007
SHIFTED	1.10	.456
GRADUATED	0.46	< .001
ENROLLED	1.34	.234

FIRST GENERATION	ODDS RATIO	P-VALUE
STOPPED	1.62	< .001
SHIFTED	1.12	.380
GRADUATED	0.42	< .001

SUBPOPULATIONS

Gender in Degree Outcomes

Female STEM students are .48 times as likely to pursue STEM degrees (p,.001), and are 1.36 times as likely to switch majors out of STEM (p=.005) than male students.



	ODDS RATIO	P-VALUE
STOPPED	0.88	.294
SHIFTED	1.36	.005
GRADUATED	0.89	.406

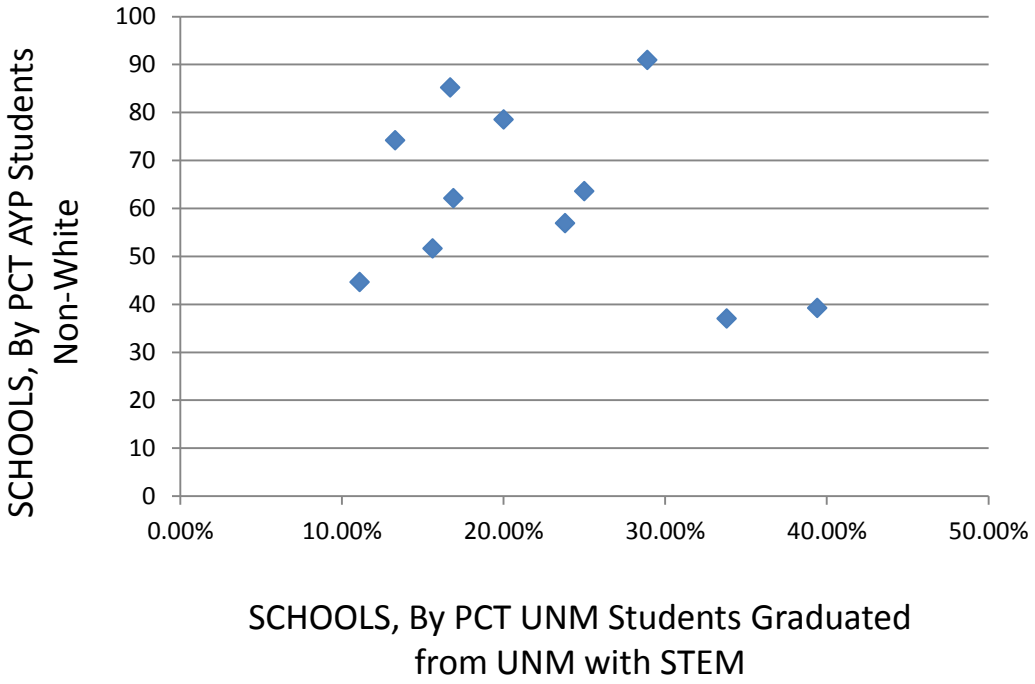
SUBPOPULATIONS

High School Origin in Degree Outcomes

HIGH SCHOOL NAME	UNM STUDENTS	GRADUATED	AYP Students PCT Non-White	AYP Students PCT Econ Disadvant
MORIARTY HIGH SCHOOL	27	**11.1%**	44.6	40.3
DEL NORTE HIGH SCHOOL	**45**	**13.3%**	**74.2**	**52.6**
RIO RANCHO HIGH SCHOOL	90	**15.6%**	51.6	37.9
HIGHLAND HIGH SCHOOL	**36**	**16.7%**	**85.2**	**71.8**
MANZANO HIGH SCHOOL	**59**	**16.9%**	**62.1**	**45.5**
LOS LUNAS HIGH SCHOOL	25	**20.0%**	78.5	66.9
SANDIA HIGH SCHOOL	**80**	**23.8%**	**56.9**	**24.6**
CIBOLA HIGH SCHOOL	**96**	**25.0%**	**63.6**	**30.1**
VALLEY HIGH SCHOOL	**38**	**28.9%**	**90.9**	**47.5**
SAINT PIUS X HIGH SCHOOL	59	**30.5%**	na	Na
ELDORADO HIGH SCHOOL	**80**	**33.8%**	**37.0**	**15.2**
ALBUQUERQUE ACADEMY	26	**38.5%**	na	na
LA CUEVA HIGH SCHOOL	**104**	**39.4%**	**39.2**	**9.6**

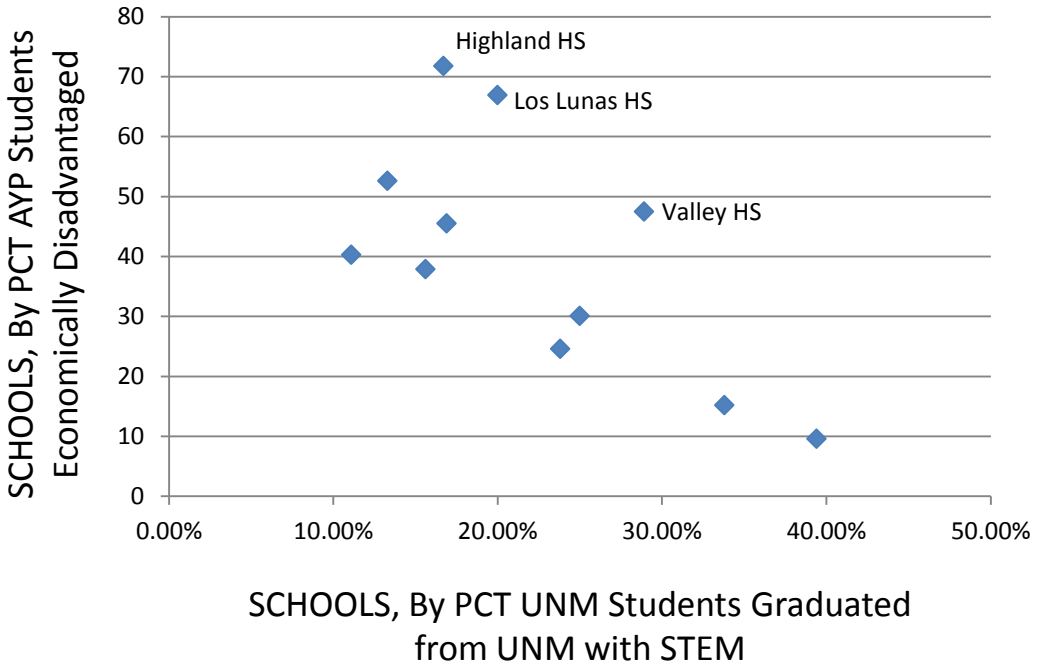
SUBPOPULATIONS

High School Origin in Degree Outcomes



SUBPOPULATIONS

High School Origin in Degree Outcomes



INSTITUTIONAL PRIORITY OF OUTCOMES

Graduate STEM

Switch Majors

Stop Attending

PRIORITY OF OUTCOMES

Variables

VARIABLE	GRADUATE	SHIFT	STOP
Percent of this group who are Pell Eligible	13.5%	23.6%	27.3%
Average of High School GPAs within this group	3.75	3.45	3.27
Average of ACT Composite scores within this group	25.8	22.9	22.2
Average of ACT Math scores within this group	26.3	22.8	22.0
Percent of this group who are First Generation	19.5%	34.2%	40.6%
Average of College GPAs within this group	**3.51**	**2.95**	**2.09**

PRIORITY OF OUTCOMES

Variables

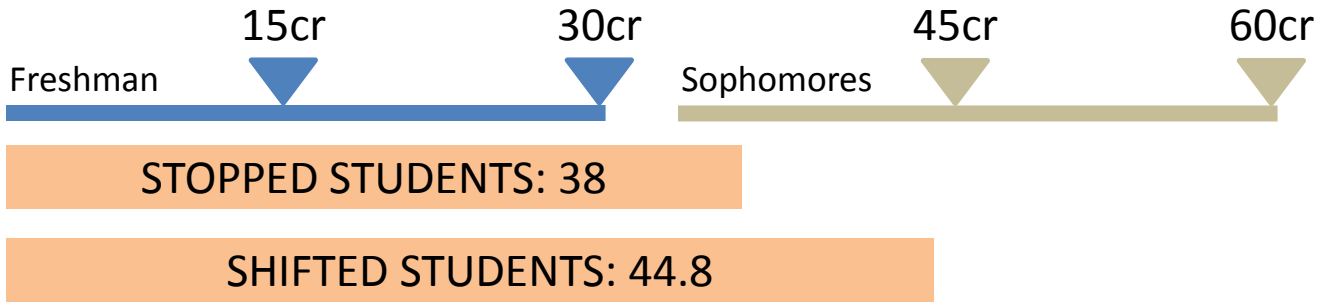
VARIABLE	GRADUATE	SHIFT	STOP
Percent of students in this group who required remediation	12%	30.7%	39.5%
Percent of students in this group who required MATH remediation	4.2%	18.2%	26.4%
Percentage of students in this group who received a Lottery Scholarship	91%	77.5%	36.9%
Percentage of Lottery-receiving students in this group who lost their Lottery Scholarship	18.4%	28.7%	42.1%

TRIGGERPOINTS

Number of Credits

The average number of credits completed when STEM students stop attending UNM is 38.

The average number of credits completed when STEM students shift majors is 44.8.

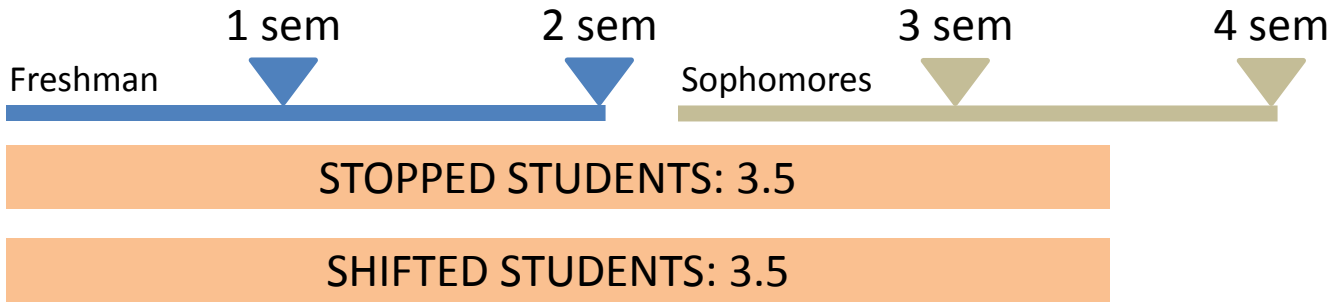


TRIGGERPOINTS

Number of Semesters

On average, STOPPED students leave UNM after 3.5 semesters.

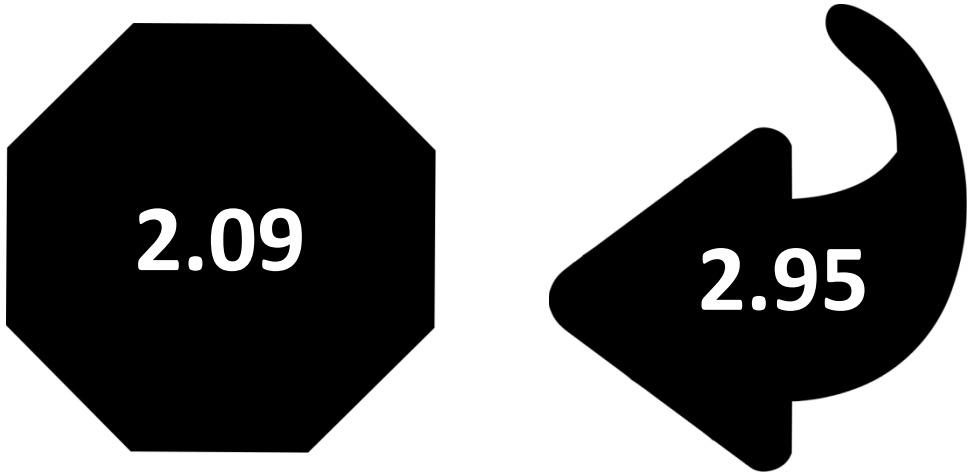
On average, SHIFTED students changed majors after 3.5 semesters, the same as for STOPPED students.



TRIGGERPOINTS

Grade Point Average

On average, STOPPED students left UNM with an average cumulative GPA of 2.08. This is contrasted by SHIFTED students, who had an average 2.94 cumulative GPA when they changed majors.



SELECTED FINDINGS
COURSE OUTCOMES LENS

ALL THE WAY TO "A"

Overview

The "UNM Killer Course List" from Fall 2011 includes eighty two courses with high enrollments (121 and above) and low student pass rates.

STEM Gateway studied the grade distribution patterns for the following sixteen STEM-based courses on this list: MATH 120, 121, 123, 150, 162, 163, 180, 181; ENVS 101; CHEM 121, 122, 301, 302; BIOL 201, 202; PHYC 160. Taken together, these courses represent a sizable portion of the gateway courses that STEM students complete en route to their degrees.

	GRADUATED	SHIFTED	STOPPED
Percentage of enrollments in this group that resulted in an A, B or C	86.18 %	65.33% (20.85 points lower than GRADUATED)	54.36% (31.82 points lower than GRADUATED)

ALL THE WAY TO "A"

Grade Distribution Patterns

Comparing GRADUATED to SHIFTED									
	A	B	C	D	F	WD	CR	NCR	ABC
Graduated	37.78	32.74	15.66	3.72	0.84	7.09	1.80	0.04	86.18
Shifted	15.19	26.05	24.09	10.88	4.73	15.68	1.55	1.60	65.33
Difference	22.59	6.69	-8.43	-7.16	-3.89	-8.58	0.25	-1.56	20.85

Comparing GRADUATED to SHIFTED									
	A	B	C	D	F	WD	CR	NCR	ABC
Graduated	37.78	32.74	15.66	3.72	0.84	7.09	1.80	0.04	86.18
Stopped	11.09	22.53	20.74	12.96	9.46	21.82	1.20	1.61	54.36
Difference	26.69	10.21	-5.08	-9.24	-8.61	-14.73	0.60	-1.58	31.82

COURSE CATEGORIES

In the table below, for each course category listed, we see the Graduation percentage for all enrollments from that category

SUBJECT	N	GRAD	SHIFT	STOP	PCT Grad	PCT Shift	PCT Stop
All Courses	9540	3475	3558	1470	**36.43%**	37.30%	15.41%
All Math Courses	3440	854	1523	693	**24.83%**	44.27%	20.15%
All Pre-Calc Math Courses	**2044**	**309**	**1047**	**492**	**15.12%**	**51.22%**	**24.07%**
All 100 Level Courses	7510	2451	2943	1288	**32.64%**	39.19%	17.15%
All <151 Level Courses	**4359**	**1016**	**2016**	**878**	**23.31%**	**46.25%**	**20.14%**
All 151-199 Level Courses	3151	1435	927	410	**45.54%**	29.42%	13.01%
All 200+ Level Courses	2030	1024	615	182	**50.44%**	30.30%	8.97%

Of the enrollments in this population from pre-calculus mathematics courses, only 15.12% led to STEM bachelors degrees at UNM.

Of the enrollments in this population from STEM Gateway courses at the 150 level or lower, only 23.31% led to STEM bachelors degrees at UNM.

COURSE CATEGORIES

The FLIPSIDE: Of students who began at UNM as first-time freshmen, and who graduated with a STEM degree in 2010-2011…

Sub-population of students	Percent of these students who completed Intermediate Algebra at UNM	Percent of these students who completed College Algebra at UNM
All STEM degree recipients	18.5%	41.2%
All Engineering degree recipients	9.8%	21.3%
All Arts & Sciences (A&S) degree recipients	23%	51.5%
A&S: Biology degree recipients	27.8%	56.8%
A&S: Non-Biology degree recipients	12.2%	40%

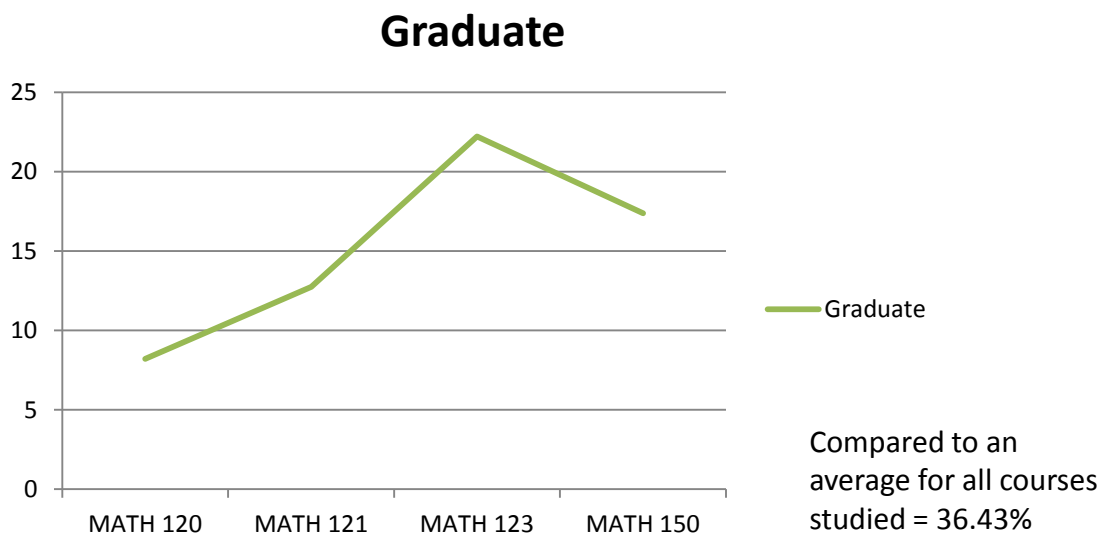
PRE-CALC MATH, ETHNICITY AND PELL-ELIGIBILITY

The following tables show grade distribution patterns for enrollments in our population for the four primary pre-cal math courses: Intermediate Algebra, College Algebra, Trigonometry and Pre-Calculus Mathematics.

Pre-Calc Math and Student Achievement

Percent of enrollments that resulted in the following outcomes…

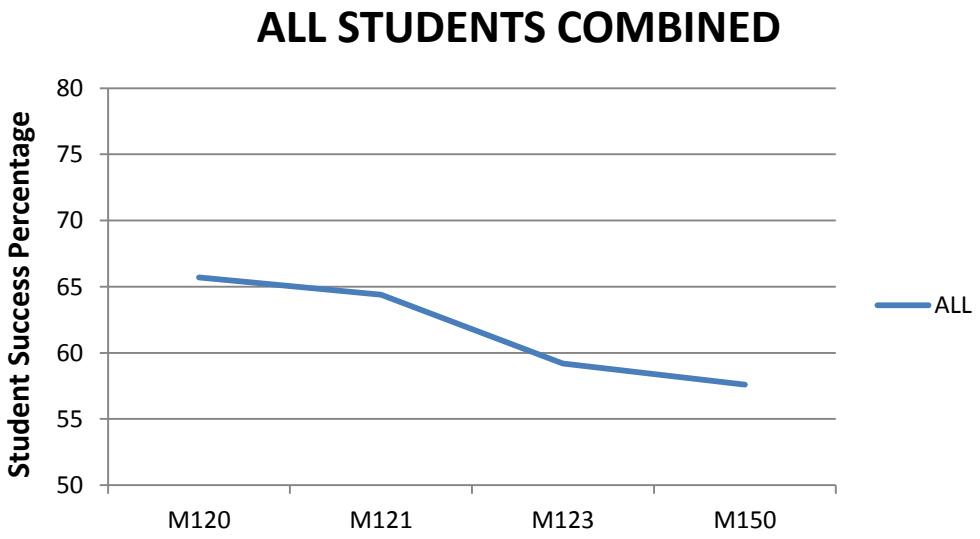
Student Outcome	MATH 120	MATH 121	MATH 123	MATH 150
Stop	25.82	21.89	24.01	26.25
Shift	59.62	57.95	39.25	44.59
Graduate	8.21	12.75	22.22	17.37
Enroll	6.33	7.40	14.32	11.77



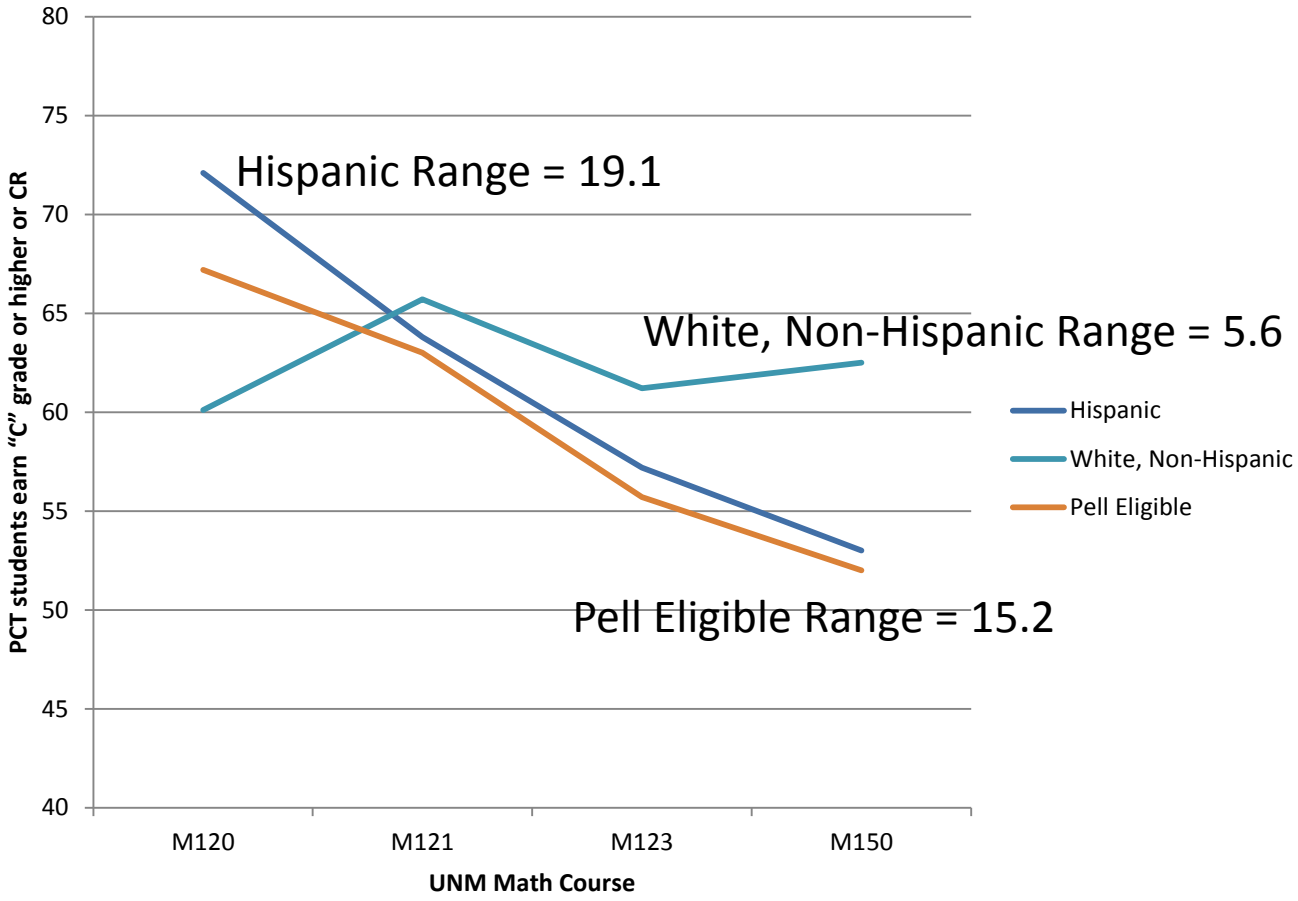
Compared to an average for all courses studied = 36.43%

Pre-Calc Math, All Students Combined

Subpopulation	N at end of semester	Pct "A"	Pct "A-B-C-CR"
MATH 120	426	15.4	**65.7**
MATH 121	635	12.9	**64.4**
MATH 123	405	15.4	**59.2**
MATH 150	518	13.4	**57.6**

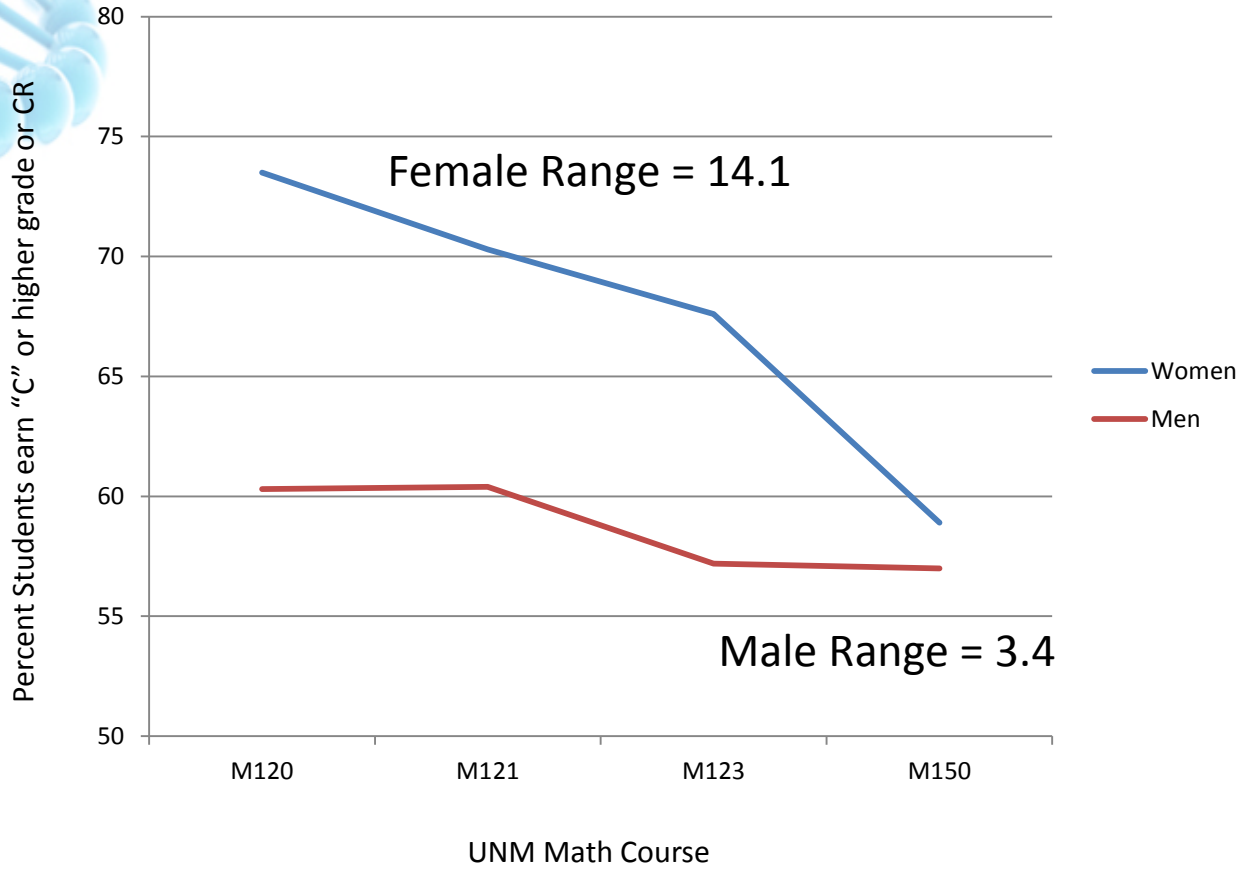


Pre-Calc Math, Ethnicity and Pell-Eligibility

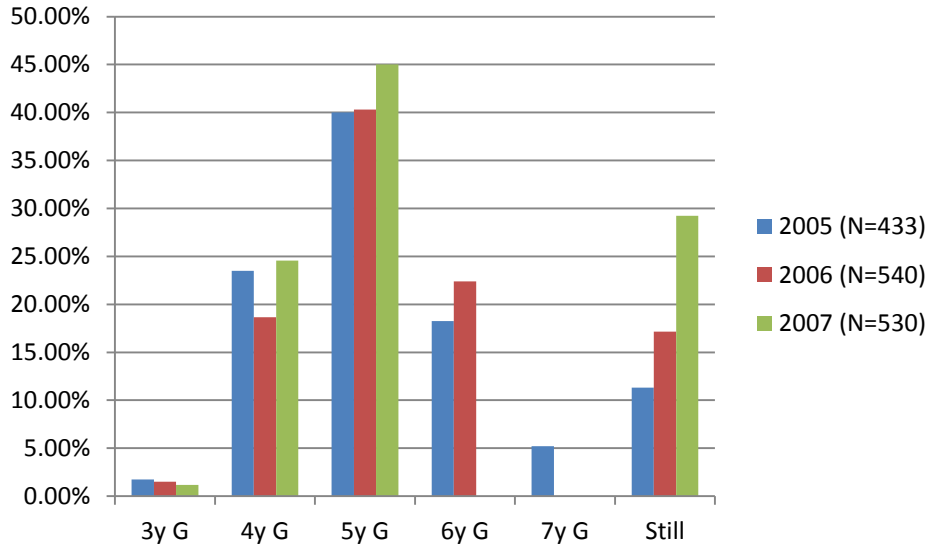


Other ethnicities excluded from this chart because their "N" in one or more of these classes was too small to be considered conclusive.

Pre-Calc Math, Gender



Time to Graduation for STEM at UNM



Quick Summary

- *Ethnicity is important to understanding STEM degree attainment.*
- *Gender is important to understanding STEM degree attainment.*

Quick Summary

- *Traditionally collected institutional variables (such as high school GPA) do align with student outcomes, but we do not yet know the ability of these to predict student achievement.*

- *Students stop attending and shift majors at roughly the same number of semesters, though major switchers collect more credits en route to that point than stoppers.*

- *Major switchers leave STEM at a "B" average, while stoppers leave UNM at a "C" average.*

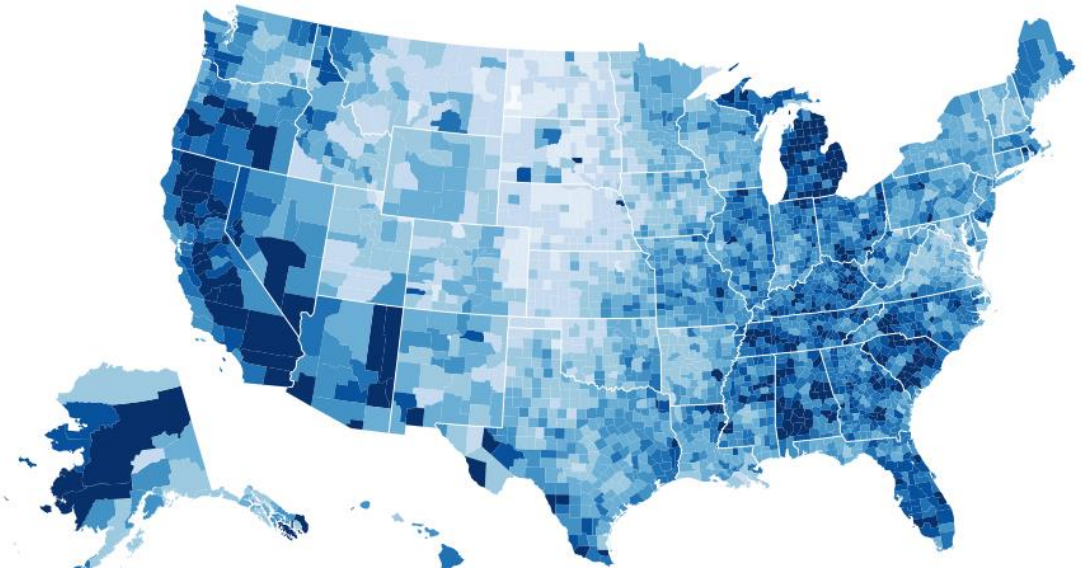
Quick Summary

- *In STEM Gateway "killer courses" the greatest difference between graduating students and non-graduating students are at the "A" range.*
- *STEM-interested students who take pre-calculus mathematics course are unlikely to graduate with STEM degrees at UNM.*
- *However, more than half of students who graduated took pre-calculus mathematics courses*

Quick Summary

- *Hispanic students and Pell-eligible students are less successful in pre-calculus math the further in they go.*
- *The average student income level of high schools matter, but to what extent is unclear*

PART 2: NATIONAL REPORTS AND STUDIES



NATIONAL ACADEMY OF SCIENCES
The Gathering Storm, 2005
Rising Above the Gathering Storm, 2010

RECOMMENDATIONS

What are the top 10 actions, in priority order, that federal policymakers could take to enhance the science and technology enterprise so that the United States can successfully compete, prosper, and be secure in the global community of the 21st century? What strategy, with several concrete steps, could be used to implement each of those actions?

1. K-12 EDUCATION. Increase American's talent pool by vastly improving K-12 science and mathematics education
2. RESEARCH MONEY: Sustain and strengthen the nation's traditional commitment to long-term basic research that has the potential to be transformational to maintain the flow of new ideas that fuel the economy, provide security, and enhance the quality of life
3. RECRUIT FROM ABROAD: Make the United States the most attractive setting in which to study and perform research so that we can develop, recruit and retain the best and brightest students, scientists and engineers within the U.S. and throughout the world
4. STRENGTHEN RESEARCH INFRASTRUCTURE: Ensure that the U.S. is the premier place in the world to innovate; invest in downstream activities such as manufacturing and marking; and create high-paying jobs based on innovation by such actions as modernizing the patent system, realigning tax policies to encourage innovation, and ensuring affordable broadband access

NATIONAL ACADEMY OF SCIENCES Expanding Underrepresented Minority Participation: America's Science and And Technology Talent at the Crossroads 2011

RECOMMENDATIONS

1. Prepare America's children for school through preschool and early education programs that develop reading readiness, provide early mathematics skills, and introduce concepts of creativity and discovery
2. Increase America's talent pool by vastly improving K-12 mathematics and science education for underrepresented minorities
3. Improve K-12 mathematics and science education for underrepresented minorities overall by improving the preparedness of those who teach these subjects
4. Improve access to all postsecondary education and technical training and increase underrepresented minority student awareness of and motivation for STEM education and careers through improved information, counseling and outreach
5. Develop America's advance STEM workforce by providing adequate financial support to underrepresented minority students in undergraduate and graduate STEM education
6. **Take coordinated action to transform the nation's higher education institutions to increase inclusion of and college completion and success in STEM education for underrepresented minorities**

EXECUTIVE OFFICE OF THE PRESIDENT
Report to the President: Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering and Mathematics, 2012

RECOMMENDATIONS

1. **Catalyze widespread adoption of empirically validated teaching practices**
2. **Advocate and provide support for replacing standard laboratory courses with discovery-based research courses**
3. **Launch a national experiment in postsecondary mathematics education to address the math preparation gap**
4. Encourage partnerships among stakeholders to diversify pathways to STEM careers
5. Create a Presidential Council on STEM Education with leadership from the academic and business communities to provide strategic leadership for transformative and sustainable change in STEM undergraduate education

NATIONAL SCIENCE FOUNDATION
Science & Engineering Indicators, 2010

PROVIDES NATIONAL AND INTERNATIONAL DATA RELATED TO:

(Chapter Two, Higher Education in Science and Engineering)

1. The U.S. higher education system
2. Undergraduate education, enrollment and degrees in the United States
3. Graduate education, enrollment and degrees in the United States
4. Postdoctoral education
5. International S&E education

(Chapter Three, Science and Engineering Labor Force)

- Scope of S&E workforce
- Employment patterns
- Demographics
- S&E labor market conditions
- Global S&E labor force

STATE OF NEW MEXICO
Higher Education Funding Formula
Technical Committee

WEBSITE, AGENDAS, PROPOSALS:
http://www.hed.state.nm.us/PR_Techcomm.aspx

For other resources, be sure to check out the following STEM Gateway Resources website:

http://unmstemgateway.blogspot.com/p/resources.html

PART 3: BRAINSTORMING

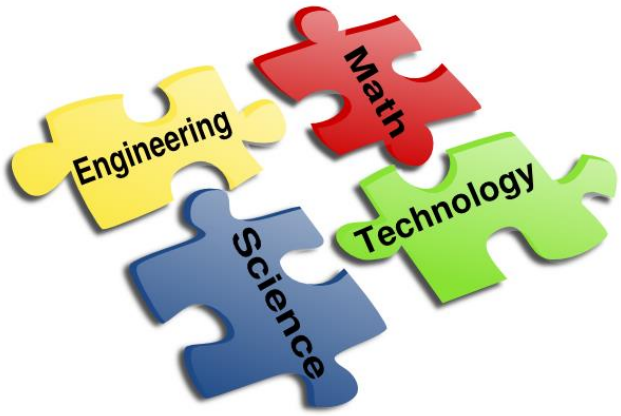
JOIN ONE OF THE FOLLOWING DISCUSSION GROUPS…

CLASSROOM INSTRUCTION AND ACADEMIC STUDENT SUPPORT	OUT OF CLASS STUDENT SUPPORT
RESEARCH AND EXPERIENTIAL LEARNING	GRADUATE STUDENT SUPPORT

Take five minutes to answer this question…

Within your discussion group theme, what is your institution doing right now to improve STEM student achievement?

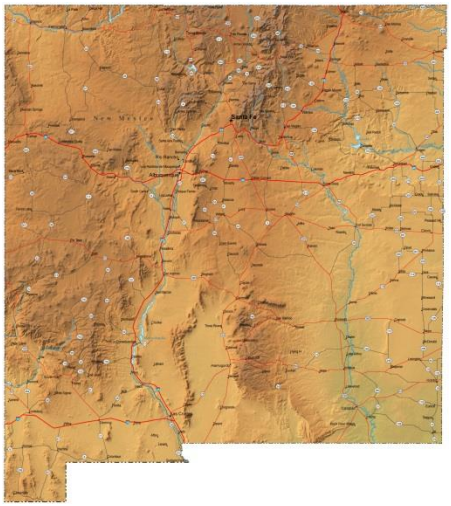
Be prepared to share with the other groups at the end of five minutes.



Take five minutes to answer this question…

Within your discussion group theme, what are three more best practices that you feel would be most effective in New Mexico?

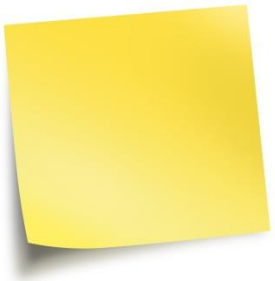
Be prepared to share with the other groups at the end of five minutes.



Everyone take three yellow sticky notes and three pink sticky notes.

PINK NOTES: **Place one note next to each idea that you feel would be most effective (up to three total).**

GREEN NOTES: **Place one note next to each idea that you feel would be easiest to implement at your institution right now (up to three total).**



Time Permitting…

Where you do find your best information (data and/or best practices) about STEM Education?

TIM SCHROEDER
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505-277-1761
http://unmstemgateway.blogspot.com/