K-12: STEM Education: How Do We Change the Gender Gap?

Presenters

Claire Duggan

Meredith Monaco

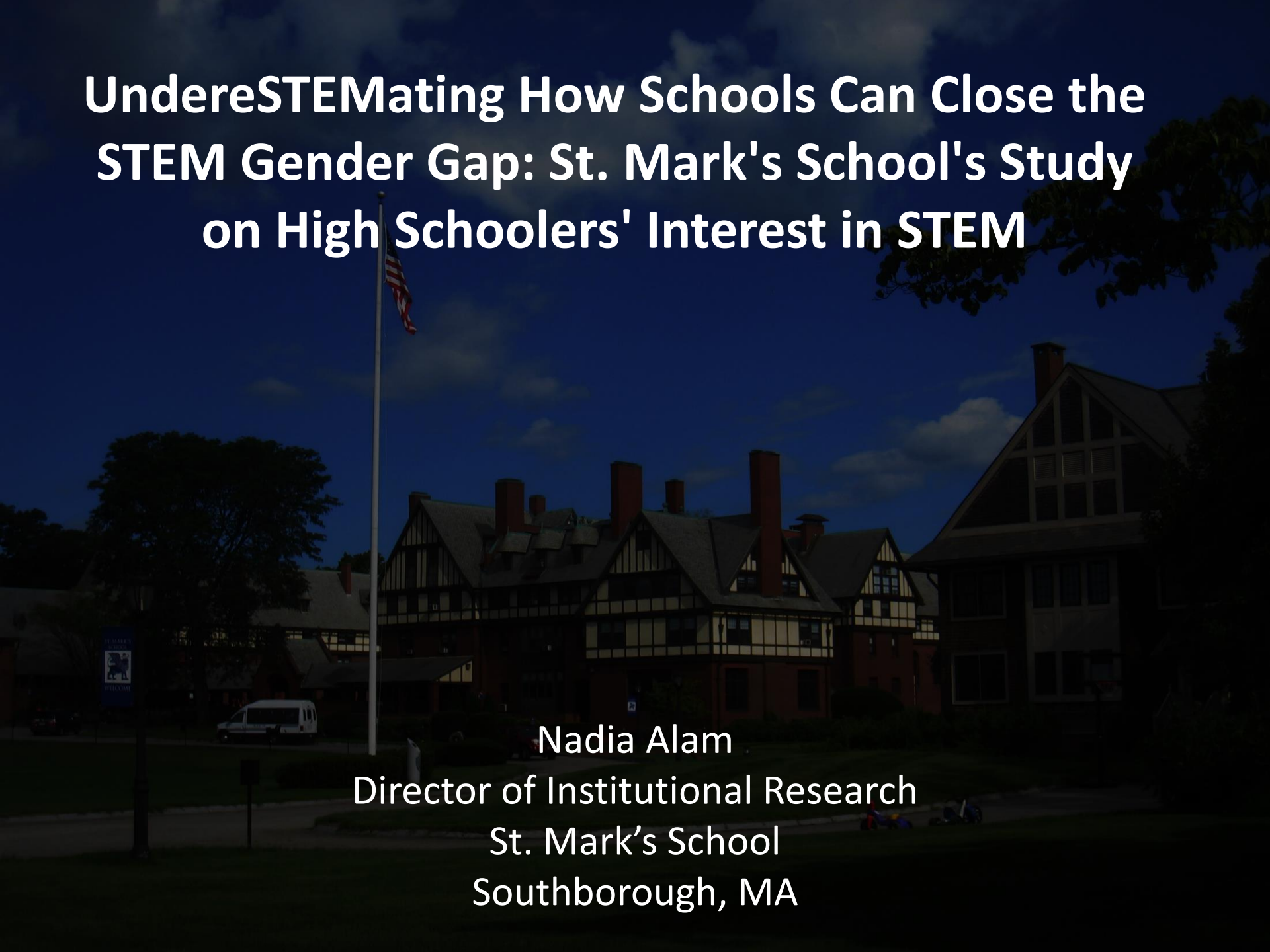
Nadia Alam

NEASC Annual Meeting

Boston Marriott Copley Place

December 10, 2015

UndereSTEMating How Schools Can Close the STEM Gender Gap: St. Mark's School's Study on High Schoolers' Interest in STEM



Nadia Alam
Director of Institutional Research
St. Mark’s School
Southborough, MA

ABOUT ST. MARK'S SCHOOL:

- Intentionally small boarding and day school in Southborough, MA
- 364 students in grades 9-12

ABOUT ST. MARK'S SCHOOL:

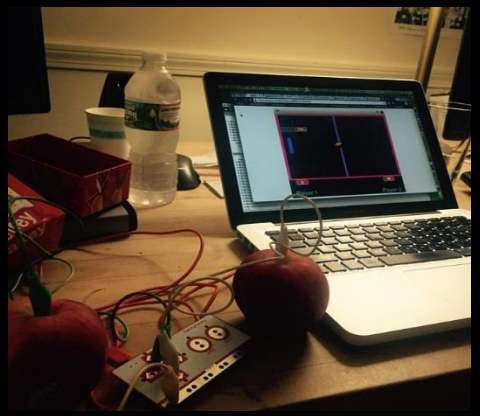
- 75% boarding, 25% day
- 30% students of color
- 21% international students
- Student body represents 19 states and 13 nations
- 31% of student body receives need-based financial aid, 5% on full financial aid
- Ave. class size = 12

ABOUT ST. MARK'S SCHOOL:

- Affiliated with Episcopal Church and rooted in that tradition, but students, staff and faculty represent a variety of faiths

The STEM Initiative

- Major focal point of St. Mark's Strategic Plan, esp. with the construction of a STEM Center in 2015
- A key goal is to attract more students into STEM, esp. girls and students of color
- Internal study was launched to identify pathways and barriers that exist for students in our school



SM STEM SURVEY:

- 36-question survey instrument (30 close-ended and 6 open-ended questions), ~15 minutes to complete
- All students at SM asked to voluntarily participate - incentive was the chance to watch the Dean of Faculty have a pie thrown in his face
- 182/361 students participated (50% RR)

ST. MARK'S STEM SURVEY STUDY SOUGHT TO ANSWER THE FOLLOWING:

1. Are students interested in pursuing STEM courses (math, science, computer science, engineering and technology) after high school? Are there gender gaps?

2. What factors are the most predictive of students' interest in pursuing STEM after high school? Are gender gaps evident?

3. Are female and male students equally confident about their present abilities and potential to succeed in STEM?

4. Does effort in school (as self reported by students) have any influence on STEM interest, grades or confidence levels?

ENROLLMENT SCAN OF STEM COURSES

Overall Enrollment in Advanced and Elective STEM Courses

2013/14 Academic Year

284 students enrolled in advanced science, advanced math and computer science courses altogether

47% female

52% male

Advanced Math Courses, 2013/14

102 students enrolled in advanced math courses altogether

50% female

50% male

Advanced Science Courses, 2013/14

123 students enrolled in advanced science courses altogether

57% female

43% male

Computer Science Courses, 2013/14

59 students enrolled in computer science courses altogether

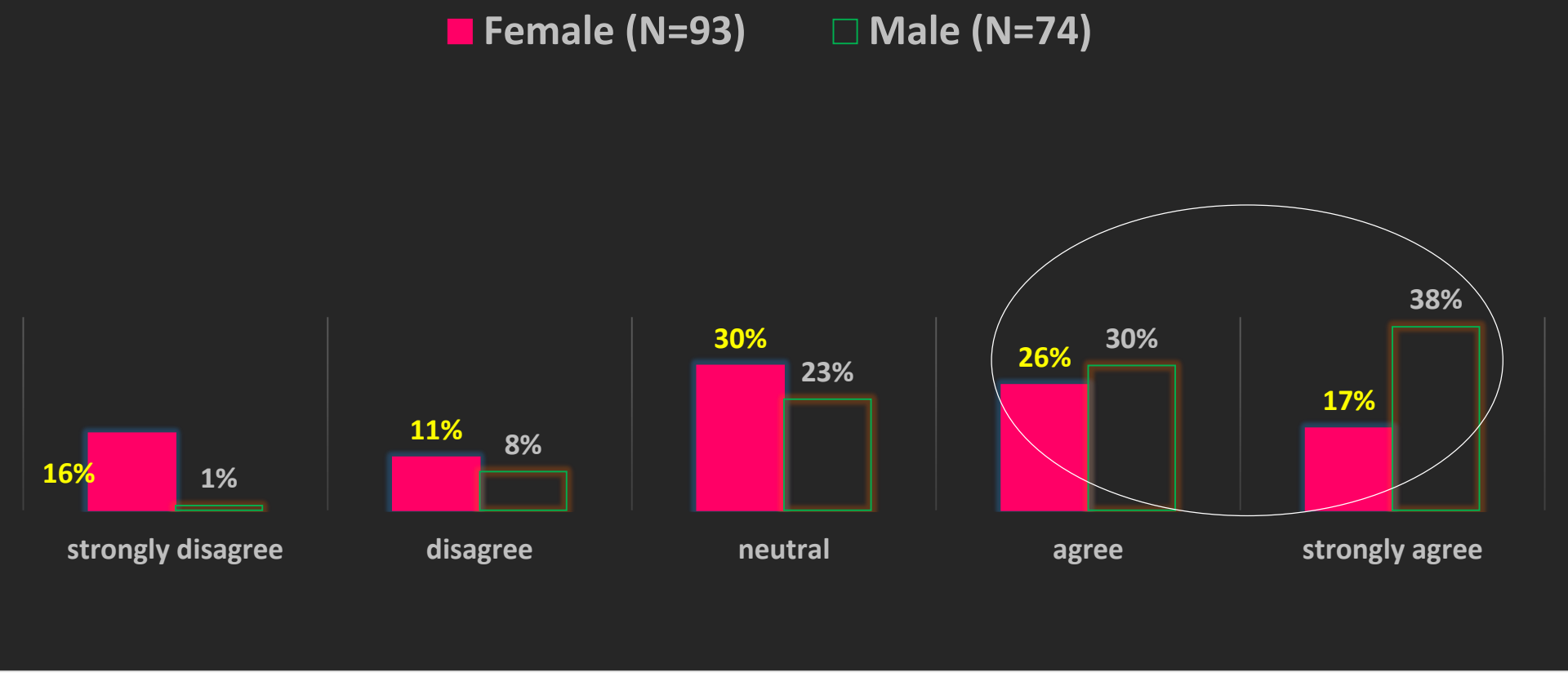
25% female (N=15)

75% male (N=44)

KEY FINDINGS

Interest in Pursuing STEM Courses (Math, Science, Computer Science, Technology & Engineering) in College

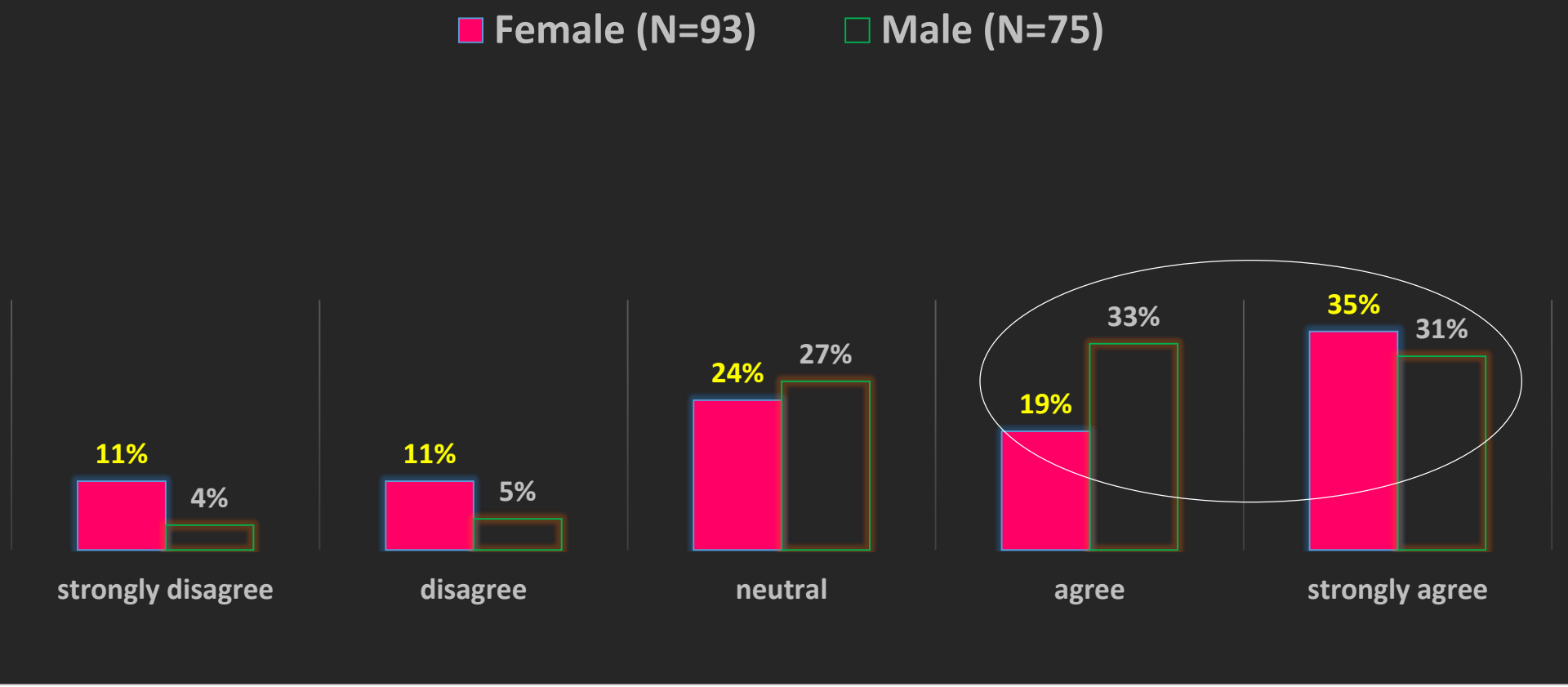
I am interested in taking math courses in college. (N=167)



Overall, 55% of students surveyed are interested in taking math courses in college.

25% more male students than female students agree that they are interested in taking math courses in college (68% of males v. 43% of females). The study finds that gender and interest in college math courses have a statistically significant relationship.**

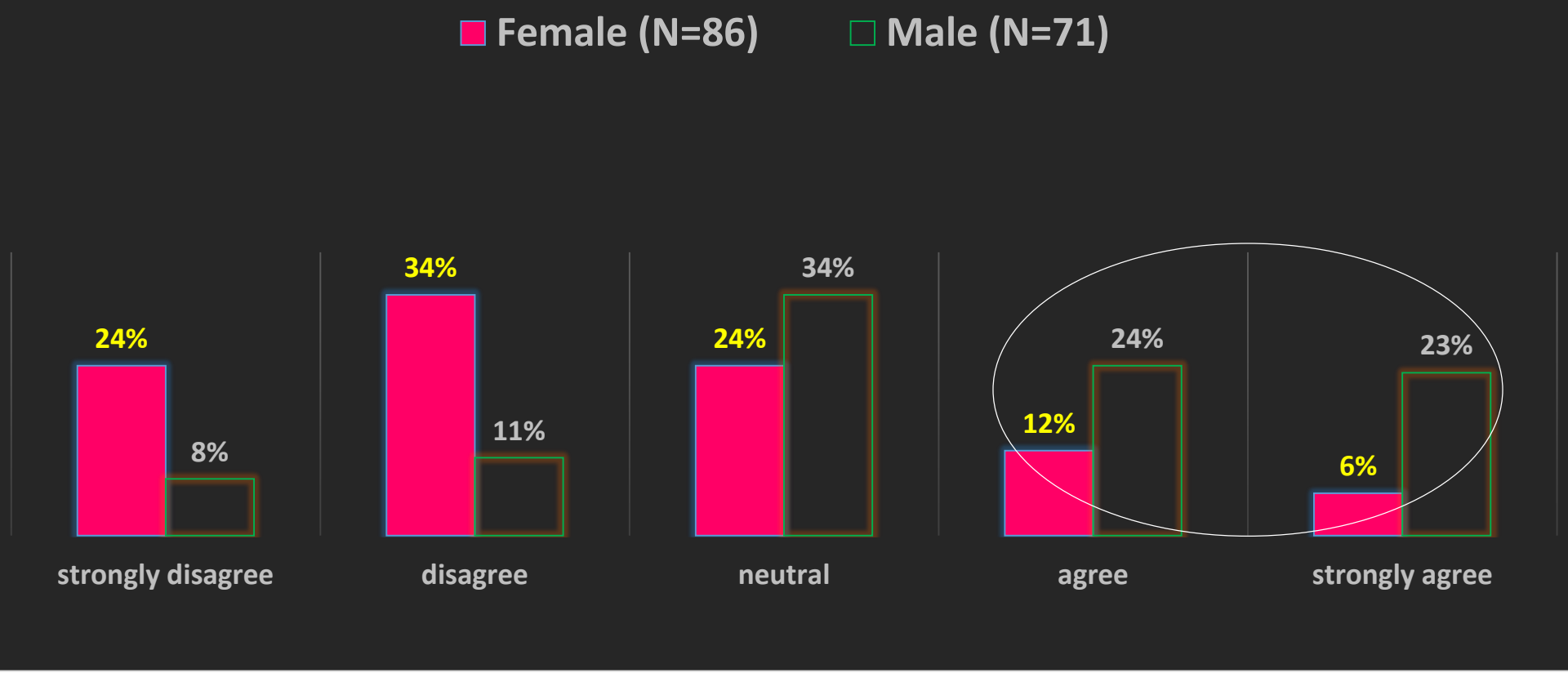
I am interested in taking science courses in college. (N=168)



Overall, 65% of students surveyed are interested in taking science courses in college.

10% more males than females are interested in taking science courses in college (64% of males v. 54% of females). Gender was not found to have a statistically significant relationship with interest in college science courses.

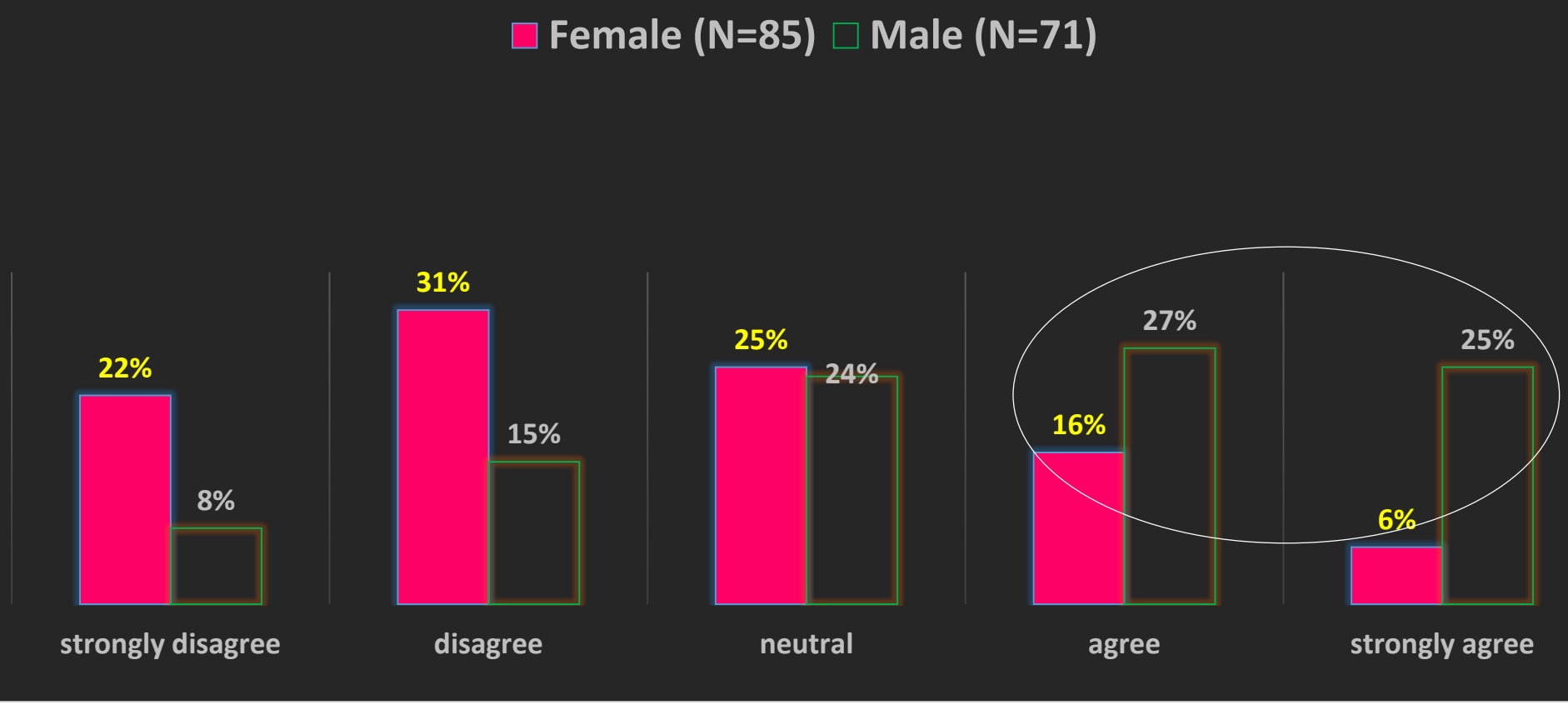
I am interested in taking computer science courses in college. (N=157)



Overall, 31% of students surveyed are interested in taking computer science courses in college overall.

29% more males than females are interested in taking computer science courses in college (47% of males v. 18% of females). Gender and interest in college computer science were found to have statistically significant relationship.****

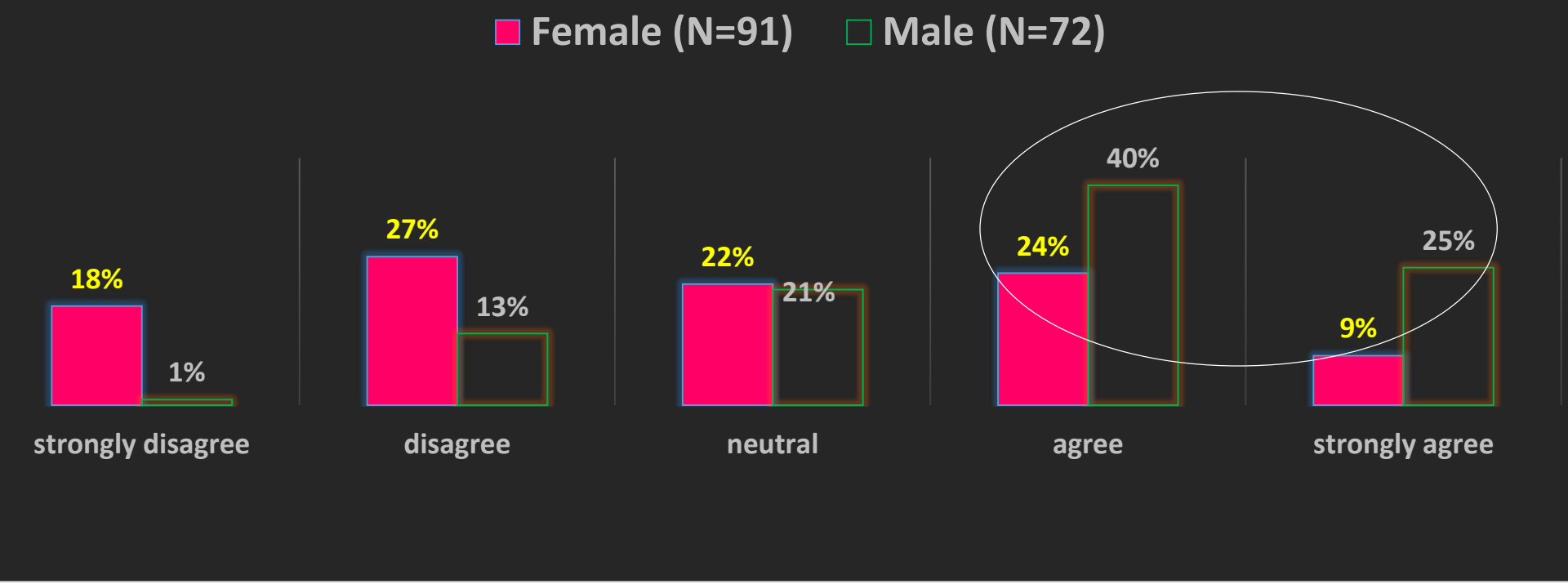
I am interested in taking engineering courses in college. (N=156)



Overall, 36% of students surveyed are interested in taking engineering courses in college.

30% more males than females show an interest in taking engineering in college (52% of males v. 22% of females). Gender was found to have a statistically significant relationship with interest in engineering courses.****

I am interested in taking technology courses (e.g. high-technology, information technology, digital technology, biotechnology, aerospace, and computer science) in college. (N=163)



Overall, 47% of students surveyed are interested in taking technology courses in college.

32% more males than females express an interest in taking technology courses in college (65% of males v. 33% of females). The study found a statistically significant relationship between gender and interest in taking technology courses.****

What We Learned:

Key Finding 1

There are notable gender gaps with regard to students' interest in taking STEM courses in college with more males than females expressing post-high school STEM interest.

Larger (and statistically significant) gaps are evident in math, computer science, engineering and technology (~30% more males than females express an interest in taking college courses in these subjects).

A smaller gender gap is seen in science (just 10% more male students than female students express interest in taking science courses in college).

Variables Associated with Interest in Pursuing STEM Courses in College

Predictor variables were grouped into five categories:

1. STEM “self-efficacy” (i.e. perception of present ability or perception of potential to succeed in STEM) (pink)

1. School-based predictors of STEM interest (e.g. courses, teachers, activities) (green)

1. Demographic characteristics like gender and race/ethnicity (blue)

1. Overlapping interest in other STEM subjects, also termed “associative STEM interest” (yellow)

1. Grades (orange)

Table 25: FACTORS ASSOCIATED WITH SM STUDENTS' INTEREST IN TAKING STEM COURSES IN COLLEGE

I am interested in taking courses in college.

	MATH	SCIENCE	ENGINEERING	COMPUTER SCIENCE	TECHNOLOGY
1	I think I would do well if I pursued a career that uses math. (chi2=143.03, Pr=0.000)	I think I would do well if I pursued a career that uses science. (chi2=232.13, Pr=0.000)	I think I would do well if I pursued a career in engineering. (chi2=334.95, Pr=0.000)	I think I would do well if I pursued a career in computer science. (chi2=278.09, Pr=0.000)	I think I would do well if I pursued a career in technology. (chi2=256.04, 0.000)
2	I am good at math. (chi2=104.29, Pr=0.000)	In general, my science classes at St. Mark's have made me more interested in science. (chi2=126.28, Pr=0.000)	My St. Mark's experience has allowed me to know more about career prospects in engineering. (chi2=178.69, Pr=0.000)	I am interested in taking technology courses in college. (chi2=144.95, Pr=0.000)	I think I would do well if I pursued a career in computer science. (chi2=173.05, Pr=0.000)
3	I can get good grades in math if I want to. (chi2=81.73, Pr=0.000)	My science teacher this year has made me more interested in studying science later in life, such as in college. (chi2=119.54, Pr=0.000)	I think I would do well if I pursued a career in technology. (chi2=112.21, Pr=0.000)	I am interested in taking engineering courses in college. (chi2=103.07, Pr=0.000)	I am interested in taking computer science courses in college. (chi2=144.95, Pr=0.000)
4	My math teacher this year has made me more interested in studying math later in life, such as in college. (chi2=77.63, Pr=0.000)	I can get good grades in science if I want to. (chi2=119.33, Pr=0.000)	I am interested in taking computer science courses in college. (chi2=103.07, Pr=0.000)	My St. Mark's experience has allowed me to know more about career prospects in computer science. (chi2=100.73, Pr=0.000)	My St. Mark's experience has allowed me to know more about career prospects in technology. (chi2=116.28, Pr=0.000)
5	I think I would do well if I pursued a career in engineering. (chi2=77.27, Pr=0.000)	I am good at science. **(chi2=113.05, Pr=0.000)**	I think I would do well if I pursued a career in computer science. (chi2=102.05, Pr=0.000)	I think I would do well if I pursued a career in technology. (chi2=97.32, Pr=0.000)	I am interested in taking engineering courses in college. (chi2=100.70, Pr=0.000)
6	I am interested in taking science courses in college. (chi2=69.20, Pr=0.000)	I am interested in taking engineering courses in college. (chi2=89.95, Pr=0.000)	I am interested in taking technology courses in college. (chi2=100.70, Pr=0.000)	I think I would do well if I pursued a career in engineering. (chi2=87.00, Pr=0.000)	I think I would do well if I pursued a career in engineering. (chi2=99.52, 0.000)
7	I think I would do well if I pursued a career in technology. (chi2=68.83, 0.000)	I am interested in taking math courses in college. (chi2=69.20, Pr=0.000)	I think I would do well if I pursued a career that uses science. (chi2=92.24, Pr=0.000)	My St. Mark's experience has allowed me to know more about career prospects in technology. (chi2=72.32, Pr=0.000)	My St. Mark's experience has allowed me to know more about career prospects in computer science. (chi2=92.42, Pr=0.000)
8	I am interested in taking engineering courses in college. (chi2=67.79, Pr=0.000)	I think I would do well if I pursued a career in technology. (chi2=69.17, Pr=0.000)	I am interested in taking science courses in college. (chi2=89.95, Pr=0.000)	My St. Mark's experience has allowed me to know more about career prospects in engineering. (chi2=69.75, 0.000)	I think I would do well if I pursued a career that uses science. (chi2=67.27, Pr=0.000)
9	I am interested in taking technology courses in college. (chi2=65.17, Pr=0.000)	I think I would do well if I pursued a career in engineering. (chi2=68.29, Pr=0.000)	My St. Mark's experience has allowed me to know more about career prospects in technology. (chi2=80.68, Pr=0.000)	I am good at math. (chi2=47.04, Pr=0.000)	I am interested in taking math courses in college. (chi2=65.17, Pr=0.000)
10	In general, my math classes at St. Mark's have made me more interested in studying math later in life. (chi2=64.80, Pr=0.000)	I am interested in taking technology courses in college. (chi2=61.37, Pr=0.000)	My St. Mark's experience has allowed me to know more about career prospects in computer science. (chi2=79.81, Pr=0.000)	I am interested in taking math courses in college. (chi2=46.15, Pr=0.000)	My St. Mark's experience has allowed me to know more about career prospects in engineering. (chi2=61.83, Pr=0.000)
11	I think I would do well if I pursued a career that uses science. (chi2=60.55, Pr=0.000)	In general, my grades are... (chi2=57.07, Pr=0.000)	I am interested in taking math courses in college. (chi2=67.79, Pr=0.000)	Took or taking computer science class at SM (chi2=41.97, Pr=0.000)	I am interested in taking science courses in college. (chi2= 61.37, Pr=0.000)
12	Math grades (chi2=59.33, Pr=0.000)	My St. Mark's experience has allowed me to know more about career prospects in engineering. (chi2=48.47, Pr=0.000)	I think I would do well if I pursued a career that uses math. (chi2=63.96, Pr=0.000)	I think I would do well if I pursued a career that uses science. (chi2=38.29, Pr=0.001)	I think I would do well if I pursued a career that uses math. (chi2=48.04, Pr=0.000)
13	Math is difficult for me. (chi2=55.43, Pr=0.000)	I think I would do well if I pursued a career in computer science. (chi=47.01, Pr=0.000)	I am good at math. (chi2=59.61, Pr=0.000)	Math is difficult for me. (chi2=37.00, Pr=0.002)	I am good at math. (chi2=43.62, Pr=0.008)
14	My St. Mark's experience has allowed me to know more about career prospects in engineering. (chi2=52.00, Pr=0.000)	My St. Mark's experience has allowed me to know more about career prospects in technology. (chi2=46.58, Pr=0.000)	Interest in STEM opportunities at SM (based on # of opportunities checked) (chi2=53.42, Pr=0.003)	I can get good grades in math if I want to. (chi2=34.10, Pr=0.005)	I can get good grades in science if I want to. (chi2=37.84, Pr=0.002)
15	I am interested in taking computer science courses in college. (chi2=46.15, Pr=0.000)	Science is difficult for me. (chi2=45.64, Pr=0.000)	My science teacher this year has made me more interested in studying science later in life, such as in college. (chi2=44.34, Pr=0.000)	I am good at science. (chi2=33.26, Pr=0.007)	I am good at science. (chi2=37.78, Pr=0.002)
16	I am good at science. (chi2=43.93, Pr=0.000)	I think I would do well if I pursued a career that uses math. (chi2=43.06, Pr=0.000)	In general, my science classes at St. Mark's have made me more interested in science. (chi2=38.32, Pr=0.001)	I think I would do well if I pursued a career that uses math. (chi2=32.80, Pr=0.008)	My math teacher this year has made me more interested in studying math later in life, such as in college. (chi2=35.23, Pr=0.004)
17	I think I would do well if I pursued a career in computer science. (chi2=39.31, Pr=0.001)	In general, my math classes at St. Mark's have made me more interested in math. (chi2=34.60, Pr=0.005)	In general, my math classes at St. Mark's have made me more interested in math. (chi2=35.35, Pr=0.004)	Ethnicity/race affiliation (chi2=32.10, Pr=0.001)	My science teacher this year has made me more interested in studying science later in life, such as in college. (chi2=33.88, Pr=0.006)
18	I can get good grades in science if I want to. (chi2=38.20, Pr=0.001)	I can get good grades in math if I want to. (chi2=33.62, Pr=0.006)	Advanced or elective course-taking in science (# of courses taken) (chi2=32.91, Pr=0.035)	I am interested in taking science courses in college. (chi2=31.89, Pr=0.010)	Math is difficult for me. (chi2=32.22, Pr=0.009)
19	In general, my grades are... (chi2=38.20, Pr=0.000)	My math teacher this year has made me more interested in studying math later in life, such as in college. (chi2=32.79, Pr=0.008)	In general, my grades are... (chi2=32.43, Pr=0.001)	In general, my math classes at St. Mark's have made me more interested in math. (chi2=30.36, Pr=0.016)	In general, my math classes at St. Mark's have made me more interested in math. (chi2=30.16, Pr=0.017)
20	My St. Mark's experience has allowed me to know more about career prospects in technology. (chi2=37.20, Pr=0.002)	I am interested in taking computer science courses in college. (chi2=31.89, Pr=0.010)	I can get good grades in math if I want to. (chi2=32.15, Pr=0.010)	I can get good grades in science if I want to. (chi2=30.11, Pr=0.017)	Took or taking computer science course (chi2=29.53, Pr=0.000)
21	My St. Mark's experience has allowed me to know more about career prospects in computer science. (chi2=30.95, Pr=0.014)	My St. Mark's experience has allowed me to know more about career prospects in computer science. (chi2=29.41, Pr=0.021)	My math teacher this year made me more interested in studying math later in life, such as in college. (chi2=31.91, Pr=0.010)	Gender (chi2=26.84, Pr=0.000)	In general, my science classes at St. Mark's have made me more interested in science. (chi2=29.00, Pr=0.024)
22	Science is difficult for me. (chi2=30.55, Pr=0.015)	Science grades (chi2=27.95, Pr=0.000)	Took or taking computer science class (chi2=30.24, Pr=0.000)	In general, my science classes at St. Mark's have made me more interested in science. (chi2=26.41, Pr=0.049)	I can get good grades in math if I want to. (chi2=26.54, Pr=0.047)
23	My science teacher this year has made me more interested in studying science later in life, such as in college. (chi2=30.55, Pr=0.015)	Math grades (chi2=16.48, Pr=0.036)	Math is difficult for me. (chi2=29.88, Pr=0.019)		Gender (chi2=24.40, Pr=0.000)
24	In general, my science classes at St. Mark's have made me more interested in science. (chi2=26.34, Pr=0.049)	Took or taking computer science class (chi2=12.59, Pr=0.013)	I am good at science. (chi2=28.71, Pr=0.026)		Math grades (chi2=21.92, Pr=0.005)
25	Gender (chi2=17.36, Pr=0.002)	English grades (chi2=9.78, Pr=0.044)	I can get good grades in science if I want to. (chi2=28.46, Pr=0.028)		
26	Science grades (chi2=16.81, Pr=0.032)		Math grades (chi2=22.03, Pr=0.005)		
27			Gender (chi2=20.27, Pr=0.000)		

Table 25: FACTORS ASSOCIATED WITH SM STUDENTS' INTEREST IN TAKING STEM COURSES IN COLLEGE

I am interested in taking courses in college.

	MATH	SCIENCE	ENGINEERING	COMPUTER SCIENCE	TECHNOLOGY
1	I think I would do well If I pursued a career that uses math. (chi2=143.03, Pr=0.000)	I think I would do well if I pursued a career that uses science. (chi2=232.13, Pr=0.000)	I think I would do well if I pursued a career in engineering. (chi2=334.95, Pr=0.000)	I think I would do well if I pursued a career in computer science. (chi2=278.09, Pr=0.000)	I think I would do well if I pursued a career in technology. (chi2=256.04, 0.000)

Table 25: FACTORS ASSOCIATED WITH SM STUDENTS' INTEREST IN TAKING STEM COURSES IN COLLEGE

I am interested in taking courses in college.

	MATH	SCIENCE	ENGINEERING	COMPUTER SCIENCE	TECHNOLOGY
1	I think I would do well if I pursued a career that uses math. (chi2=143.03, Pr=0.000)	I think I would do well if I pursued a career that uses science. (chi2=232.13, Pr=0.000)	I think I would do well if I pursued a career in engineering. (chi2=334.95, Pr=0.000)	I think I would do well if I pursued a career in computer science. (chi2=278.09, Pr=0.000)	I think I would do well if I pursued a career in technology. (chi2=256.04, 0.000)
2	I am good at math. (chi2=104.29, Pr=0.000)	In general, my science classes at St. Mark's have made me more interested in science. (chi2=126.28, Pr=0.000)	My St. Mark's experience has allowed me to know more about career prospects in engineering. (chi2=178.69, Pr=0.000)	I am interested in taking technology courses in college. (chi2=144.95, Pr=0.000)	I think I would do well if I pursued a career in computer science. (chi2=173.05, Pr=0.000)
3	I can get good grades in math if I want to. (chi2=81.73, Pr=0.000)	My science teacher this year has made me more interested in studying science later in life, such as in college. (chi2=119.54, Pr=0.000)	I think I would do well if I pursued a career in technology. (chi2=112.21, Pr=0.000)	I am interested in taking engineering courses in college. (chi2=103.07, Pr=0.000)	I am interested in taking computer science courses in college. (chi2=144.95, Pr=0.000)
4	My math teacher this year has made me more interested in studying math later in life, such as in college. (chi2=77.63, Pr=0.000)	I can get good grades in science if I want to. (chi2=119.33, Pr=0.000)	I am interested in taking computer science courses in college. (chi2=103.07, Pr=0.000)	My St. Mark's experience has allowed me to know more about career prospects in computer science. (chi2=100.73, Pr=0.000)	My St. Mark's experience has allowed me to know more about career prospects in technology. (chi2=116.28, Pr=0.000)
5	I think I would do well if I pursued a career in engineering. (chi2=77.27, Pr=0.000)	I am good at science. (chi2=113.05, Pr=0.000)	I think I would do well if I pursued a career in computer science. (chi2=102.05, Pr=0.000)	I think I would do well if I pursued a career in technology. (chi2=97.32, Pr=0.000)	I am interested in taking engineering courses in college. (chi2=100.70, Pr=0.000)

What We Learned:

Key Finding 2:

Among St. Mark's students, the greatest predictor of interest in college STEM courses is the belief that one will "do well" in a STEM career.

Specifically, students who agreed with the statement[s]: "I think I would do well if I pursued a career in [math/science/computer science/engineering/technology]" were the most likely to show an interest in taking these subjects in college, and by a significant margin.

This is now commonly referred to as "SELF-EFFICACY."

SELF-EFFICACY = “A person's estimate or personal judgment of his or her own ability to succeed in reaching a specific goal…”

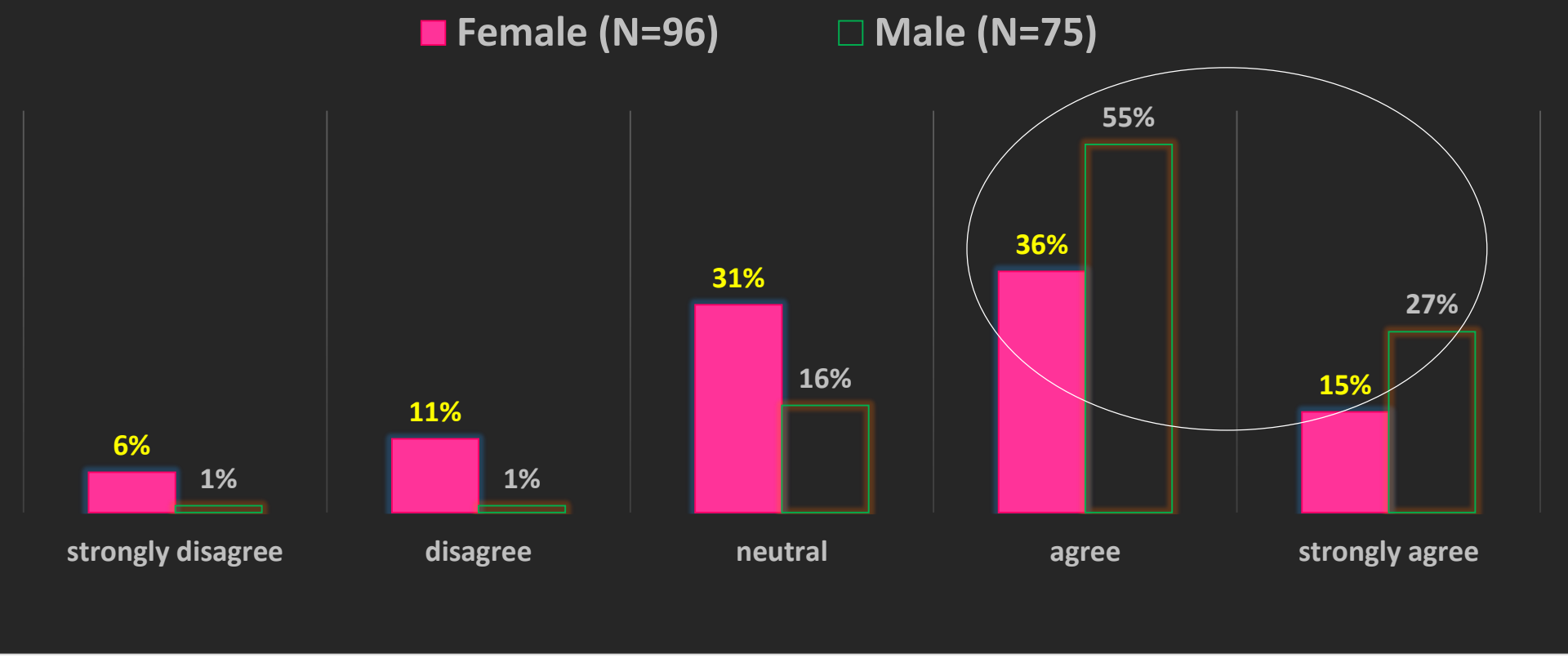
--Farlex Partner Medical Dictionary (2012)

Additional statistically significant predictors of interest in taking STEM courses in college include school-based factors like math and science teachers (especially true for science) and math and science classes; knowledge of STEM career paths; and to a lesser extent, math and science grades (self-reported by students).

Self-Efficacy at St. Mark's: Descriptive Statistics


I can do it!

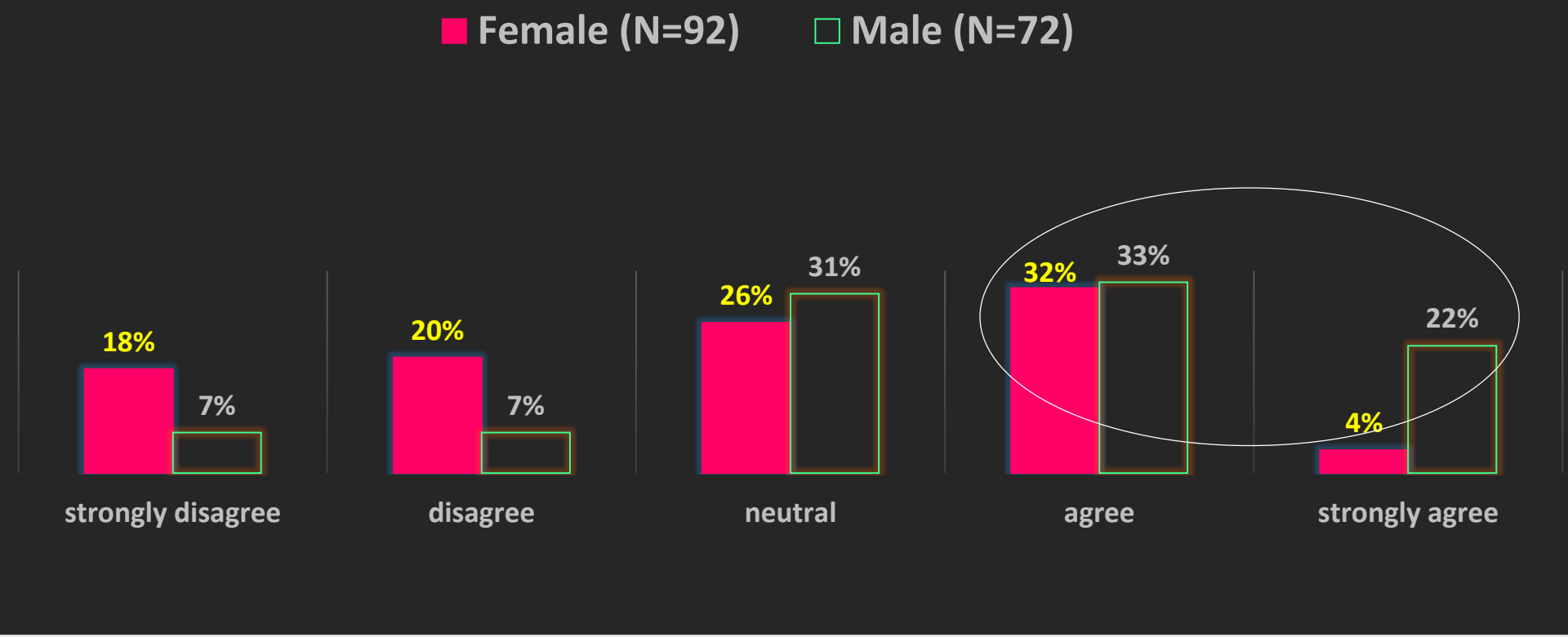
I am good at math. (N=171)



Overall, 64% of students surveyed agree with the statement: "I am good at math."

31% more males than females agree with the statement "I am good at math" (82% of males v. 51% of females). Gender was found to have a statistically significant relationship with believing one is "good at math."***

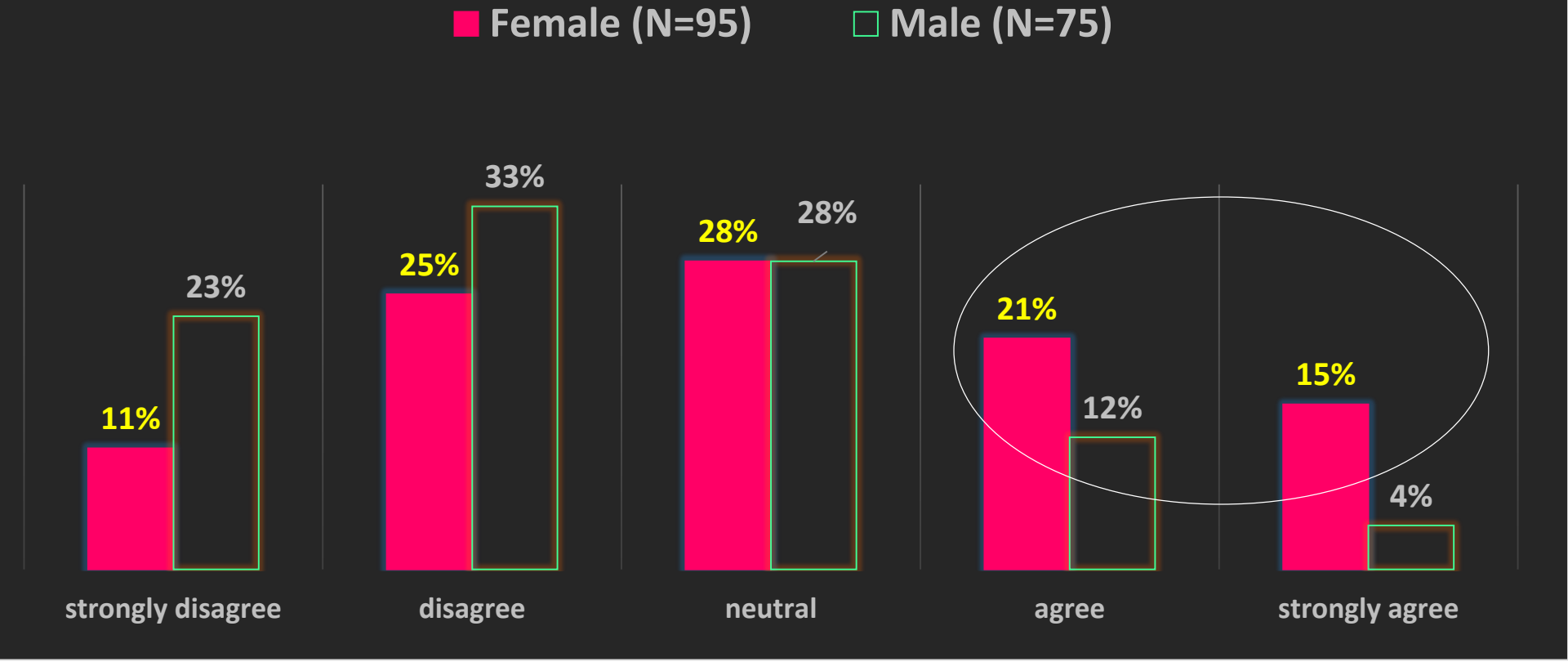
I think I would do well if I pursued a career that uses math. (N=164)



Overall, 44% of students surveyed agree with the statement "I think I would do well if I pursued a career that uses math."

19% more males than females agree with the statement "I think I would do well if I pursued a career that uses math" (55% of males v. 36% of females). Gender was found to have a statistically significant relationship with the belief in the statement "I think I would do well if I pursued a career that uses math."***

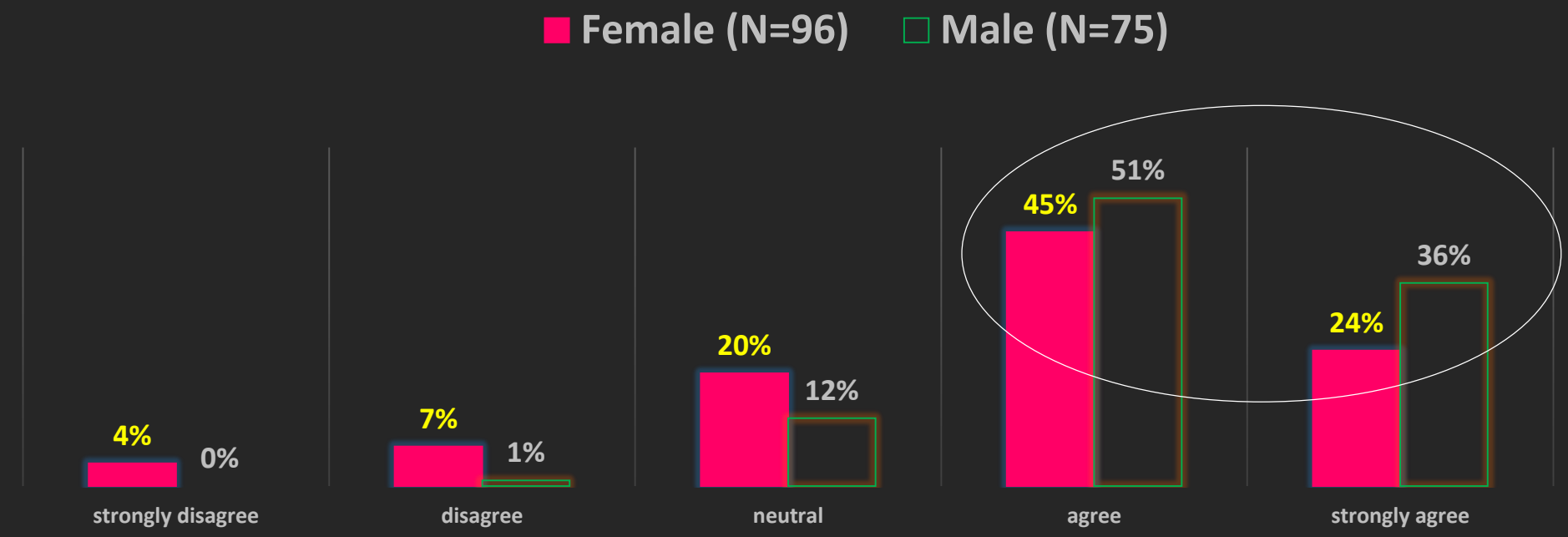
Math is difficult for me.



Overall, 28% of students surveyed agree with the statement "Math is difficult for me."

20% more females than males agreed with the statement "math is difficult for me" (36% of females v. 16% of males). Gender was found to have a statistically significant relationship with agreement with the statement "math is difficult for me."**

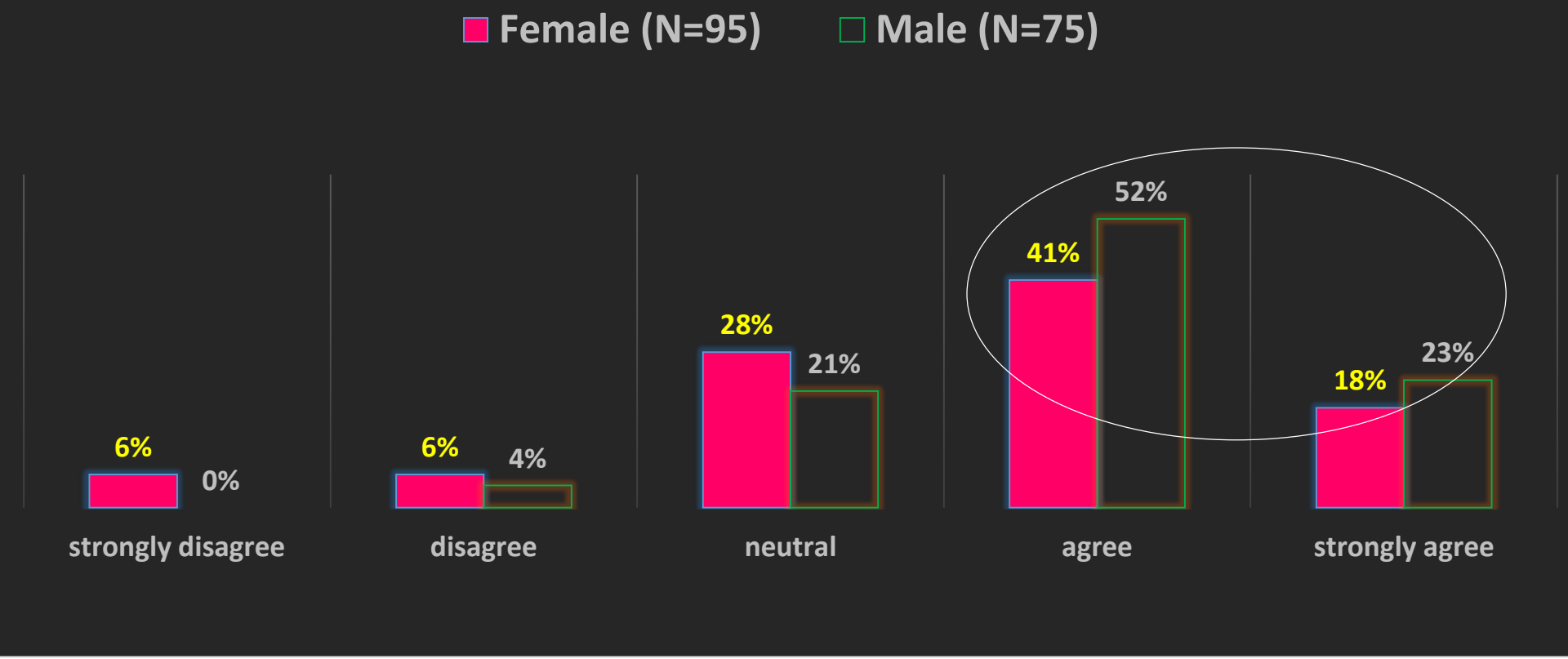
I can get good grades in math if I want to. (N=171)



Overall, 76% of students surveyed agree with the statement "I can get good grades in math if I want to."

18% more males than females feel that they can get good grades in math if they want to (87% of males v. 69% of females). Gender was found to have a statistically significant relationship with the belief that one can get good grades in math if they want to."**

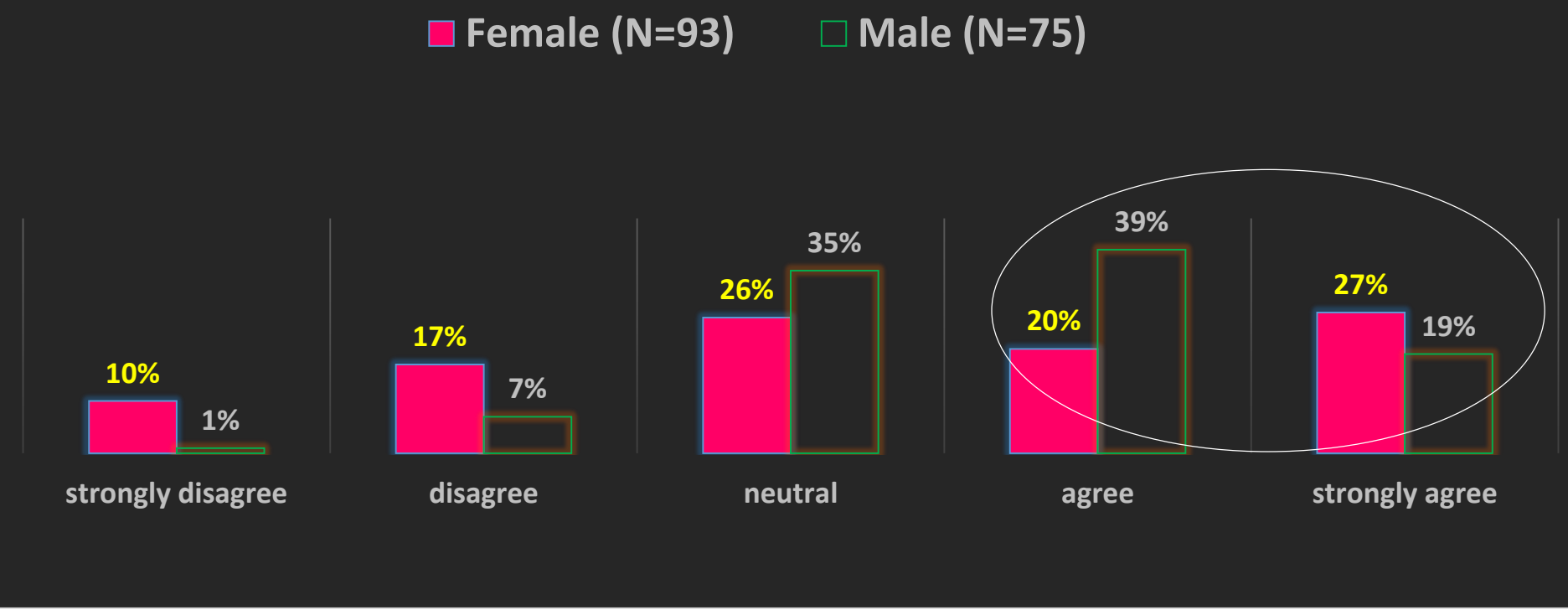
I am good at science (N=170)



Overall, 65% of students surveyed agree with the statement: "I am good at science."

16% more males than females agree that they are good at science (75% of males v. 59% of females). Results are not statistically significant.

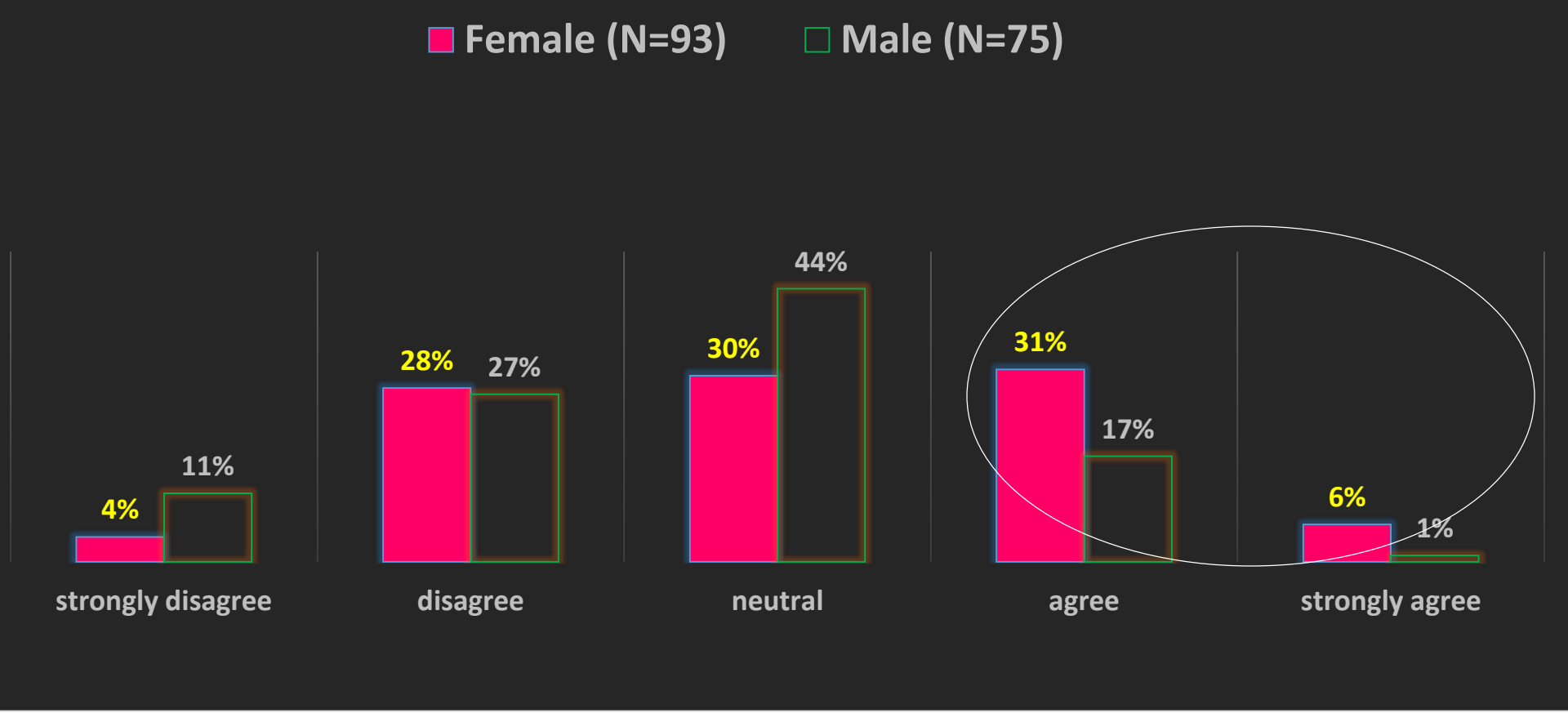
I think I would do well if I pursued a career that uses science. (N=168)



Overall, 52% of student surveyed agree with the statement "I think I would do well if I pursued a career that uses science."

11% more males than females believe they would do well if they pursued a career that uses science: (58% of males v. 47% of females). Results are not statistically significant.

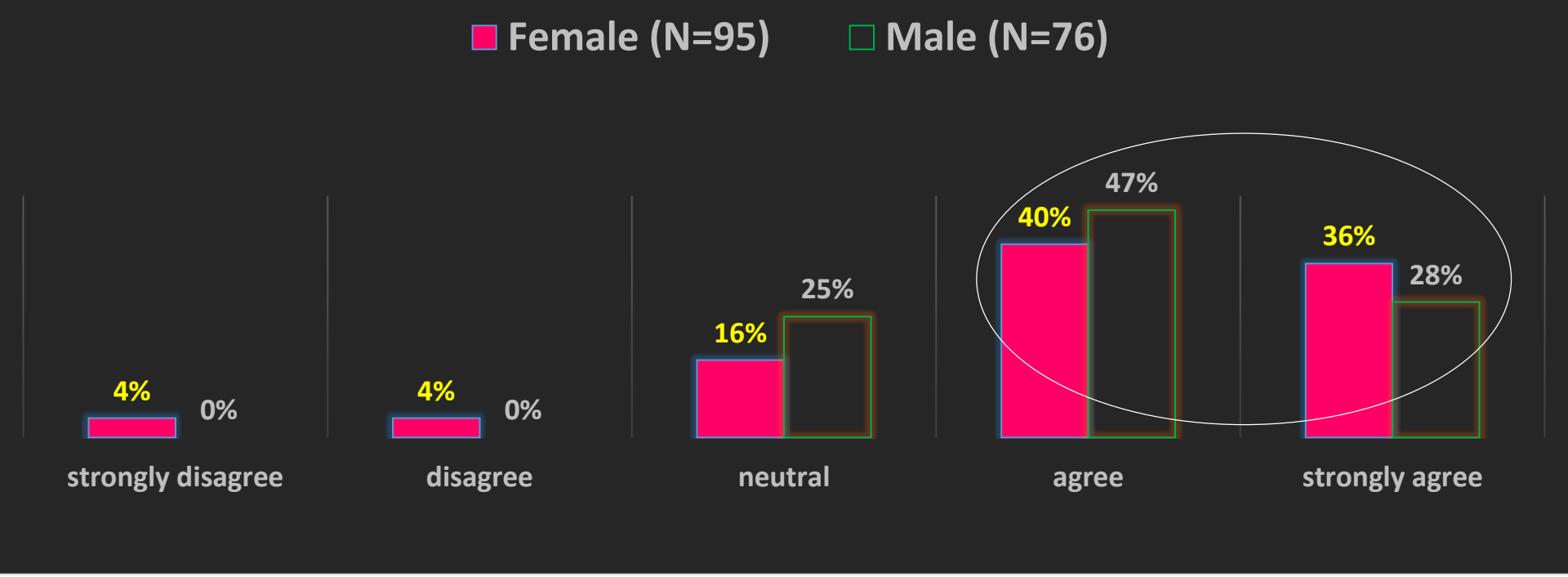
Science is difficult for me. (N=168)



Overall, 30% of students surveyed agree with the statement "Science is difficult for me."

19% more females than males agree that science is difficult for them (37% of females v. 18% of males). Gender and the belief that "science is difficult for me" were found to have a statistically significant relationship.**

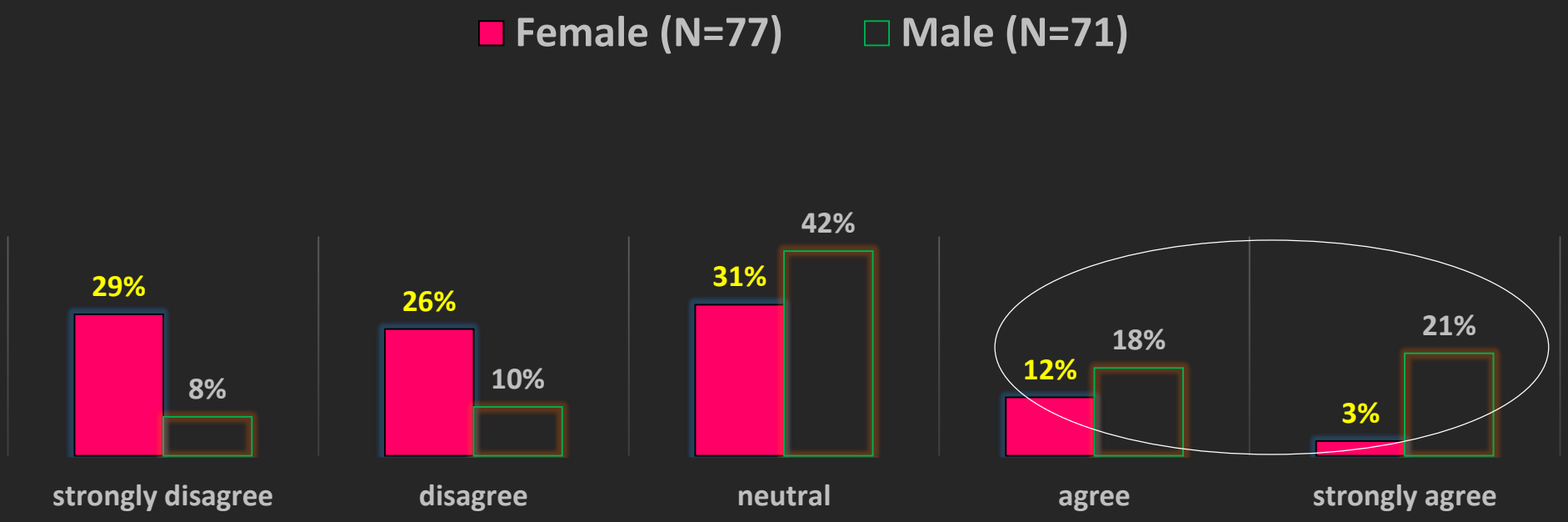
I can get good grades in science if I want to. (N=171)



Overall, 76% of students surveyed agree with the statement: "I can get good grades in science if I want to."

Male and female students were about equally likely to indicate that they can get good grades in science if they want to (76% of females v. 75% of males). Results are not statistically significant for gender.

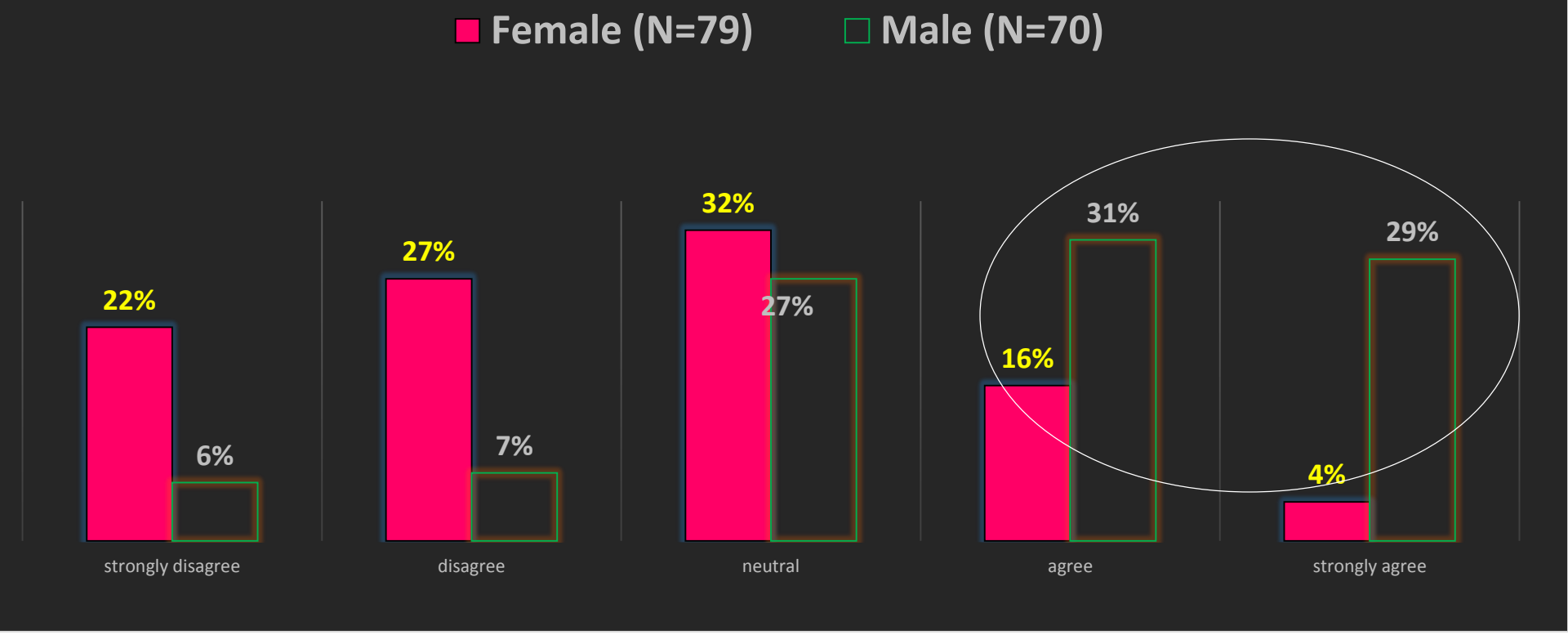
I think I would do well if I pursued a career in computer science. (N=148)



Overall, 26% of students surveyed agree with the statement "I think I would do well if I pursued a career in computer science."

24% more males than females believe they would do well if they pursued a career in computer science (39% of males v. 15% of females). Gender was found to have a statistically significant relationship with the belief that would do well if they pursued a career in computer science.***

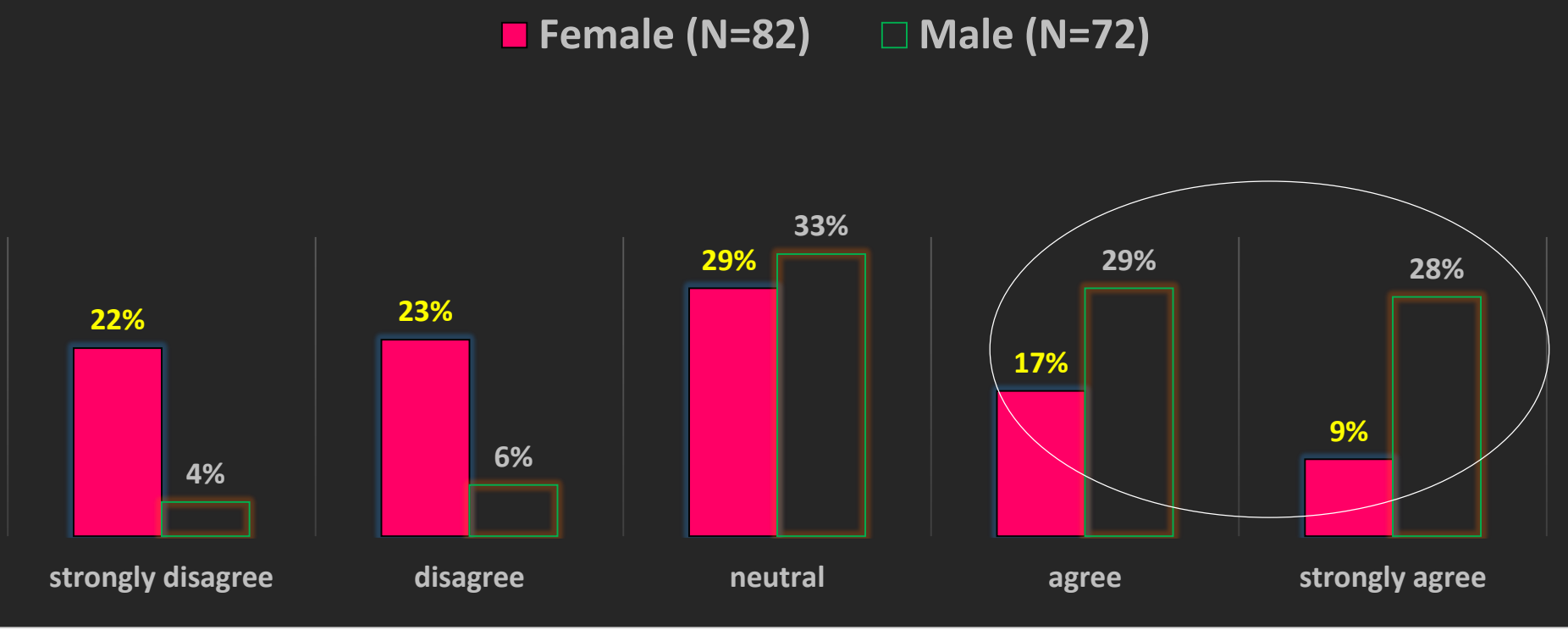
I think I would do well if I pursued a career in engineering. (N=149)



Overall, 39% of students surveyed agree with the statement "I think I would do well if I pursued a career in engineering."

40% more males than females believe they would do well if they pursued a career in engineering (60% of males v. 20% of females). Gender was found to have a statistically significant relationship with the belief that would do well if they pursued a career in engineering.****

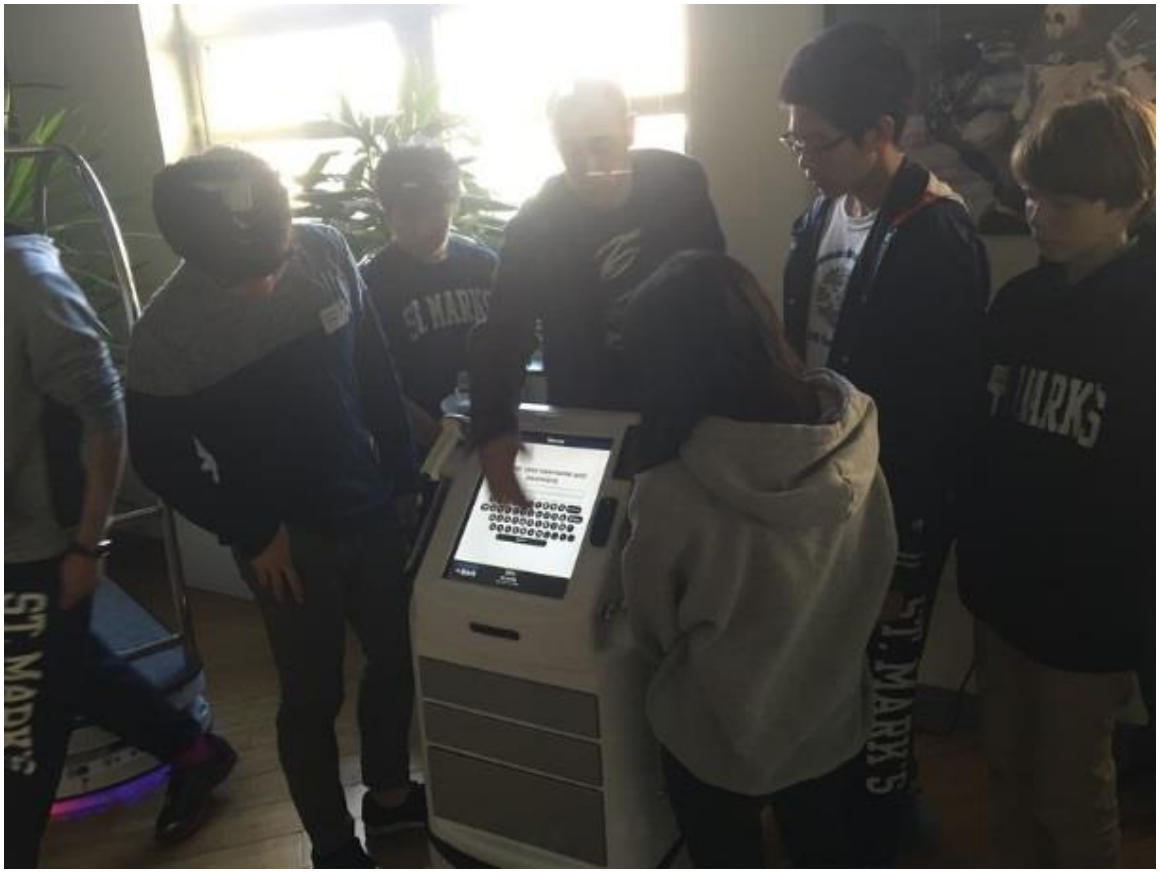
I think I would do well if I pursued a career in technology. (N=154)

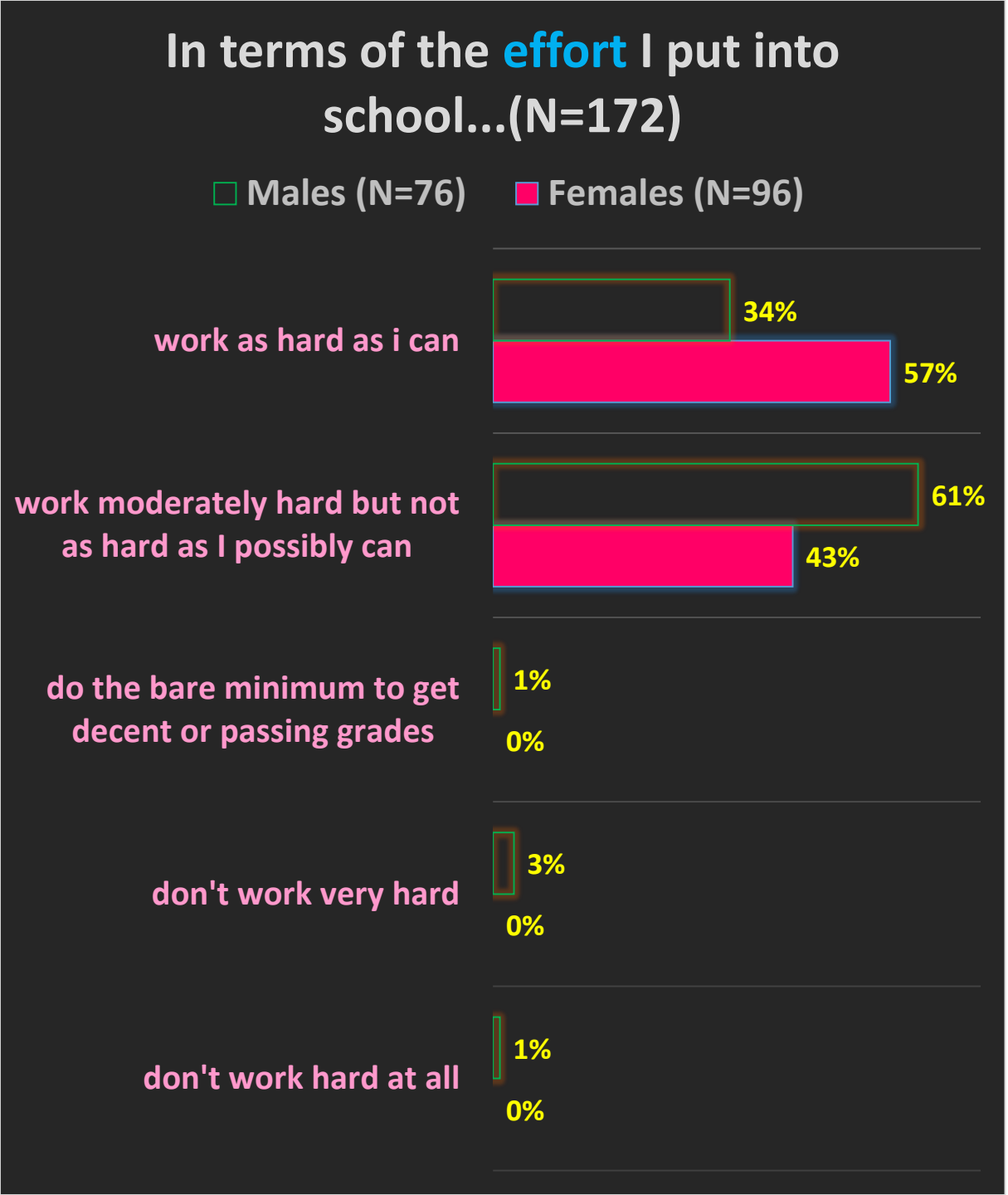


Overall, 40% of students surveyed agree with the statement "I think I would do well if I pursued a career in technology."

31% more males than females believe they would do well if they pursued a career in technology (57% of males v. 26% of females). Gender was found to have a statistically significant relationship with the belief that would do well if they pursued a career in engineering.****

Does effort in school (self-reported) influence STEM interest, grades or self-efficacy?





Considerably more female students say they "work as hard as I can" in school (57% of females v. 34% of males).

There *is* a statistically significant relationship between effort in school and gender.

What is effort in school associated with in regard to STEM?

Variable 1	Variable 2	Results Statistically Significant?	P value
EFFORT IN SCHOOL	**Participation in STEM extracurriculars**	No	
EFFORT IN SCHOOL	**Interest in taking STEM courses in college**	No	
EFFORT IN SCHOOL	**Advanced/elective STEM course-taking**	No	
EFFORT IN SCHOOL	**Grades in general**	Yes	****
EFFORT IN SCHOOL	**Science grades**	Yes	****
EFFORT IN SCHOOL	**Math grades**	No	
EFFORT IN SCHOOL	**Gender**	Yes	**
EFFORT IN SCHOOL	**Self-efficacy in STEM subjects**	No	


now
what?
tomorrow
yesterday

SO NOW WHAT?

- Time to digest and process the study and new information
- Establishing a STEM Collaborative and STEM Subcommittee on Underrepresented Students & Girls
- Gender Audit conducted in 2014/15 school year
- More intentional about Career Day – bringing in more women and people of color in various STEM fields and careers
- Reviewing our curriculum, both course offerings and variability of choices

SO NOW WHAT?

- Considering more intentional ways to support and offer feedback to boys and girls to increase self-efficacy
- STEM dashboard
- Professional development
- Exploration of bias training
- Membership at GAINS

Q.WHAT CAN I DO?

Questions?

Nadia Alam
nadiaalam@stmarksschool.org

Northeastern

Women in STEM

Enhancing women's interest and achievement in STEM majors and careers

Claire J. Duggan, Director for Programs and Operations, The Center for STEM Education

c.duggan@neu.edu

http://www.stem.neu.edu/

"RISING ABOVE THE GATHERING STORM"

What actions should federal policy makers take to enhance the science and technology enterprise so the United States can successfully compete in the global community of the 21st century?

TEN THOUSAND TEACHERS, TEN MILLION MINDS

Increase America's talent pool by vastly improving K-12 mathematics and science education.

Recommendations For Teachers

- Summer Institutes
- Science and mathematics master's programs
- AP and pre-AP training
- K-12 curriculum materials modeled on world-class standards

Recommendations for Students

- Statewide specialty math/science high schools
- Inquiry-based learning
- Summer internships and research opportunities

National Recommendations

Current landscape

Women have earned **57%** of all bachelor's degrees and about half of all science and engineering (S&E) bachelor's degrees since the late 1990s. However, women's level of participation in S&E fields varies, and within fields it tends to be consistent over every degree level. In most fields, the proportion of degrees awarded to women has risen since 1993. The proportion of women is lowest in engineering, computer sciences, and physics.

- 1980's 5.8% of engineers were women
- 2014 14% of practicing engineers are women
- 2014 18% of engineering undergraduates are women.
- 2015 26% of NU undergraduates are women. (16% in 2006)

http://www.nsf.gov/nsb/

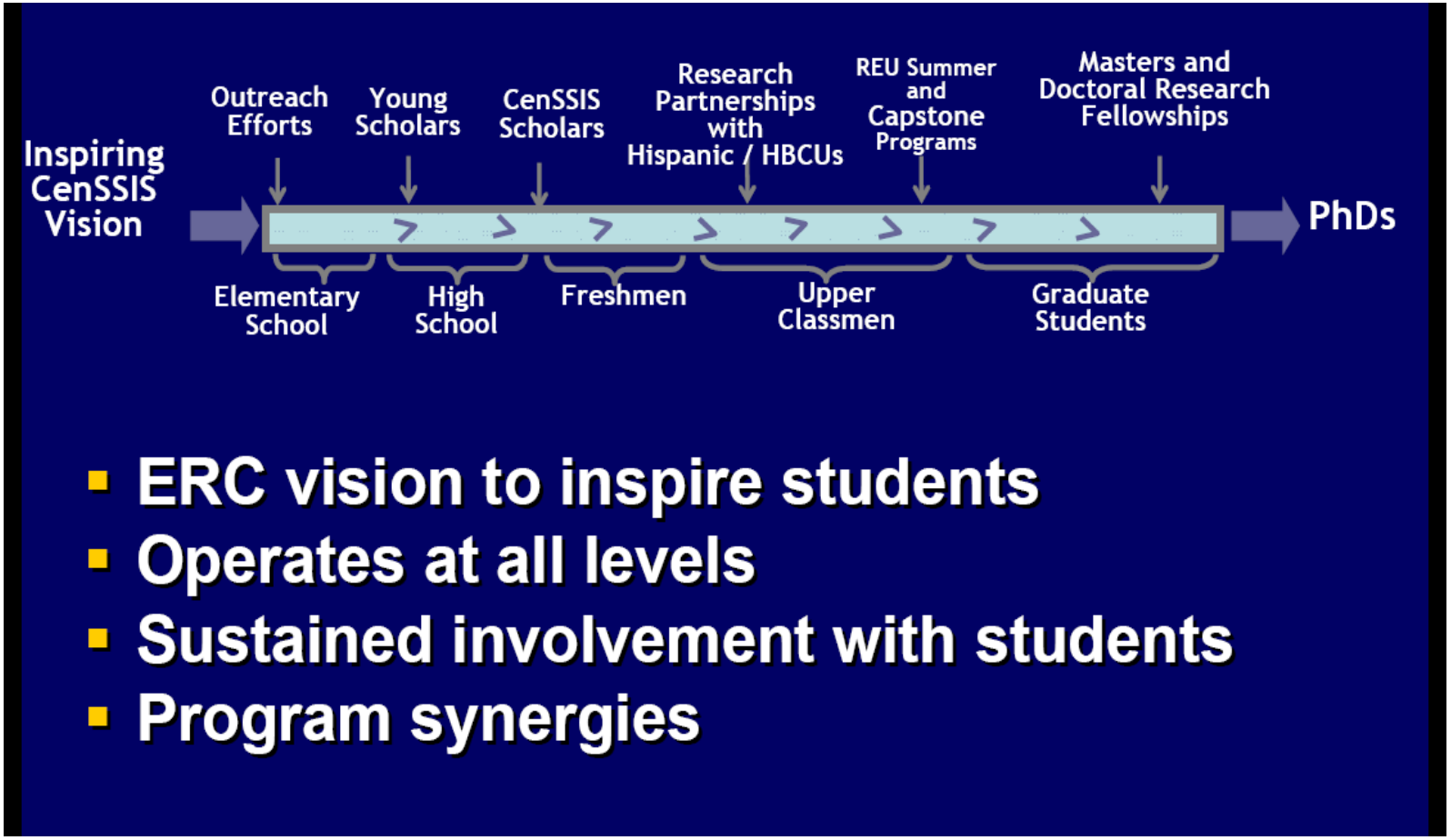
Recommendations for Engaging Women in STEM

- Make programs accessible
- Research based
- Evidence of Success
- Girl “centered”

https://ngcproject.org/engaging-girls-stem

The Northeastern University Story

Building a STEM Pipeline



History of K-12 Outreach – Federally Funded Education Initiatives

YEAR	ACTIVITY	FUNDING
1989	Launched Young Scholars Initiative at Northeastern University (Silevitch/Duggan/)	NSF/Foundation
1990	Project SEED (Silevitch/Cromer/Zahopoulos)	NSF
1991	RE-SEED initiative (Silevitch/Zahopoulos/Cromer)	NSF
1991	CESAME (The Center for the Enhancement of Science and Mathematics Education) Teacher Enhancement Project (Silevitch/Duggan/Decker/Pelletier/Bondorew)	NSF
1992	MA state systemic initiative (Silevitch/CESAME)	NSF
1993	Training Teacher Leaders (Silevitch/Zahopoulos/Cromer)	NSF
1998	CESAME/IMPACT Project– NSF Math/Science Implementation Center (Silevitch/Duggan))	NSF
2001	Launched RET program through supplemental support (Silevitch/Duggan) GK12-PLUS (Gilbert/Duggan)	NSF
2002	RET site award (Duggan/DiMarzio)	NSF
2007	RET Supplement (Silevitch)	NSF
2007	RET Site Award (Silevitch/Duggan), NSF STEP-UP (Zahopoulos, Duggan)	NSF
2007	Established The Center for STEM Education (Zahopoulos/Duggan) DHS Center for Excellence – ALERT (K-12 Outreach requirement)	University/EMC DHS
2009 2011 2014	ITEL – Investing in Tomorrow's Engineering Leaders; (Zeid/Duggan) CAPSULE/ITEST (Zeid/Duggan/Kamarthi) LSAMP Research Study (Metghalchi/Harris/Duggan) TRANSFORM (Zeid/Duggan/Kamarthi	NSF

Critical Components to supporting an Education Outreach Program

Leadership committed to education outreach

Recognition for faculty and students engaged in education outreach

Recognition for teachers

Strong partnerships with teachers, school districts and Community Colleges

Diversified Funding (NSF, DHS, Corporate and Foundation Support)

Create an infrastructure that can support your educational programming long term – at NU launch of The Center for STEM – educational outreach arm for Research Centers and Research grants and more……

Outreach informed by Federal Guidelines..

Broader Impacts criterion:

"How well does the activity advance discovery and understanding while promoting teaching, training, and learning?

How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)?

To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships?

Will the results be disseminated broadly to enhance scientific and technological understanding?

What may be the benefits of the proposed activity to society?"

These questions help to assess the potential of the proposed activity - beyond the research, *per se* - to benefit the Nation. ***Thus, the Broader Impacts criterion speaks directly to the mission of the National Science Foundation, "To promote the progress of science; to advance the national health, prosperity, and welfare; and to secure the national defense." (NSF Act of 1950).***

Build a culture of collaboration

- Build a community for those interested and willing to be part of the educational outreach
  - Volunteers
  - Full and Part-time Staff
  - Service Learning in partner schools/classrooms

  (STEM , Education, Language Skills)

The Center for STEM provides assistance to faculty with….

- Brainstorming re: possible educational outreach plans
- Providing information re: recent reports and recommendations in STEM Education
- Facilitating partnerships with local schools/school districts/teachers for your education efforts
- Writing and/or secure letters of commitment
- Providing opportunities for collaboration with existing Broader Impact programs such as the STEM Field Trip Series, Summer STEM Program, Young Scholars, in addition to RET and REU program efforts.
- Assisting with implementation of education components

Provide early introductions to STEM..

- **STEM Field Trip Series** for Elementary and Middle School students (transportation/lunch provided) approximately 1,000 students reached annually.
- **Classroom visits.**
- **STEM Summer Programs** for Middle School students .
- **After school STEM programs** in informal settings – libraries/community centers

Society of Women Engineers
ASPIRE • ADVANCE • ACHIEVE

NATIONAL SOCIETY OF BLACK ENGINEERS

Broaden participation of under-represented groups, for example, ***by establishing collaborations with students and faculty from institutions and organizations serving women, minorities, and other groups under-represented in STEM.***

Current Northeastern Engineering Outreach Programs…

Engineering Wednesdays, Women in Engineering Day, Building Bridges

http://www.nsf.gov/pubs/gpg/broaderimpacts.pdf.

Work with partner organizations promoting STEM Education and Innovation

- Girl Scouts
- Big Brother/Big Sister
- Science Club for Girls
- AAAS
- MA Pipeline initiative
- AAAS National Meeting
- Community organizations

CAMBRIDGE SCIENCE FESTIVAL
PRESENTED BY THE MIT MUSEUM

BOSTON Area GIRLS STEM Collaborative
Science • Technology • Engineering • Mathematics

Provide access to early Research experiences

Host students from local Community Colleges , HBCU's and local High Schools.

(http://www.stem.neu.edu/programs/ysp/)



https://drive.google.com/file/d/0B5PkO9pcOK83S2VJazlMMzVKbG8/view?ts=5664de

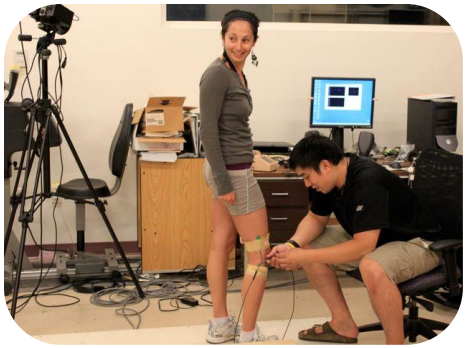
Center for STEM Education

- 421 middle school students have been directly supported to date. Half of all program participants are female.
- 414 high school students have engaged in an early research experience at NU. Half of all participants are female.
- 85% of program alumni are currently enrolled and/or have completed a bachelor's degree in a STEM field.
- All programs offered ***free of charge*** to participants.

RET-PLUS Northeastern University

- Over 100 teachers to date have spent their summers conducting research at Northeastern University.

- Over 15,000 students have been impacted



- 32 public school districts spanning six states have been represented.

Building university capacity to sustain outreach

Bottom Up and Top Down….

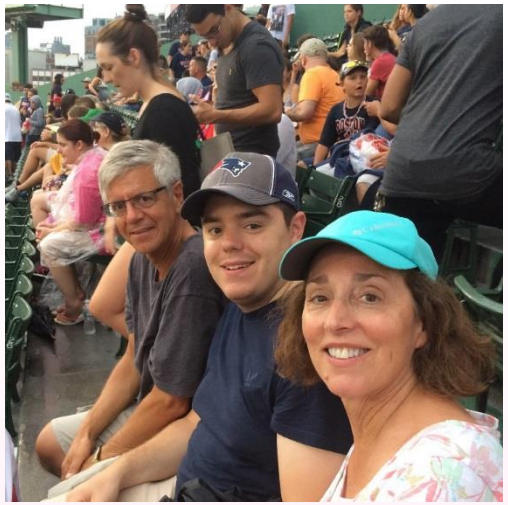
- Building a **student** STEM Community
- Building a **faculty** STEM Community
- **Building connections** between students and faculty beyond the classroom
- **Research Driven**
- **Evidence of Success**

Meredith Monaco

Founder

About Me

- Bethlehem Central HS – Albany, NY
- Northeastern University – B.S. in Mechanical Engineering
- Northeastern University – M.B.A in International Business
- Raytheon – since 2009

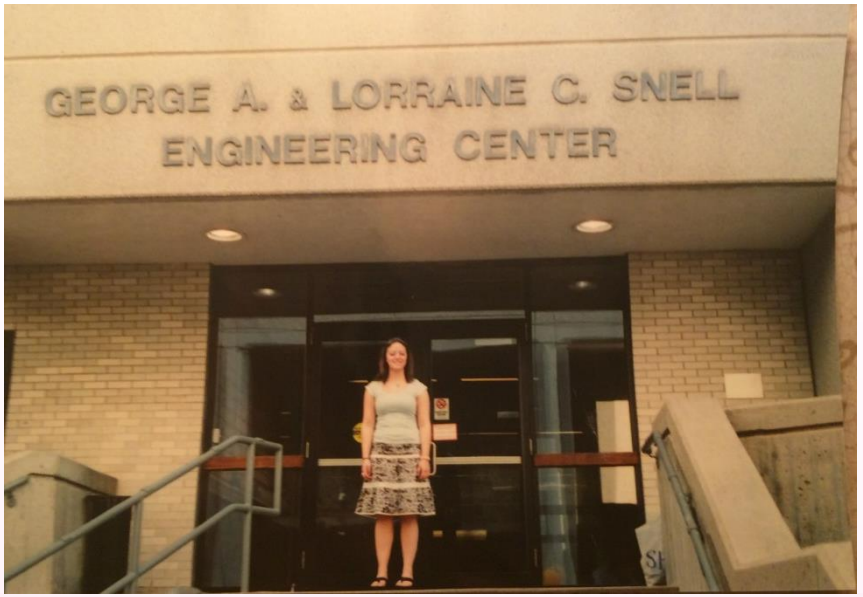


Lead in to Engineering

- Dolls AND Legos
- Interested in “how stuff works”
- Success in math and science classes
- Strong support system

Undergrad at Northeastern

- Mechanical Engineering Major
- Connections Scholar – National Science Foundation
- Freshman Dorm – Engineers & other STEM students



Now

- Manufacturing Program Manager – Above Water Sensors
  - Mix of engineering and business
- Founder of Girl Lab!

Source: US Navy

Why can't I be smart AND cute?

Engineers are nerds

Engineering is for guys

Really?!

But you're a girl!

Women don't belong in the lab

Awkward silence

Why is engineering only interesting when my husband talks about it?

Math is easier for boys

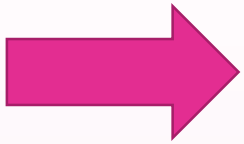
What is Girl Lab!

- Club within the Boys & Girls Club for Middle School Girls
- Introduce Girls to Engineering and other STEM subjects

Girl Lab! Goals

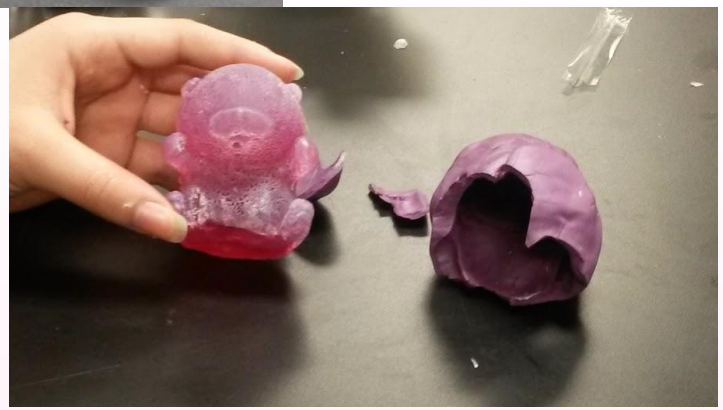
- Teach girls about STEM subjects
- Introduce them to STEM careers
- Show that STEM can be fun and feminine at times
- Give alternatives to stereotypes of female scientists/engineers

- Structure:
  - 6 week sessions
  - Mostly standalone activities



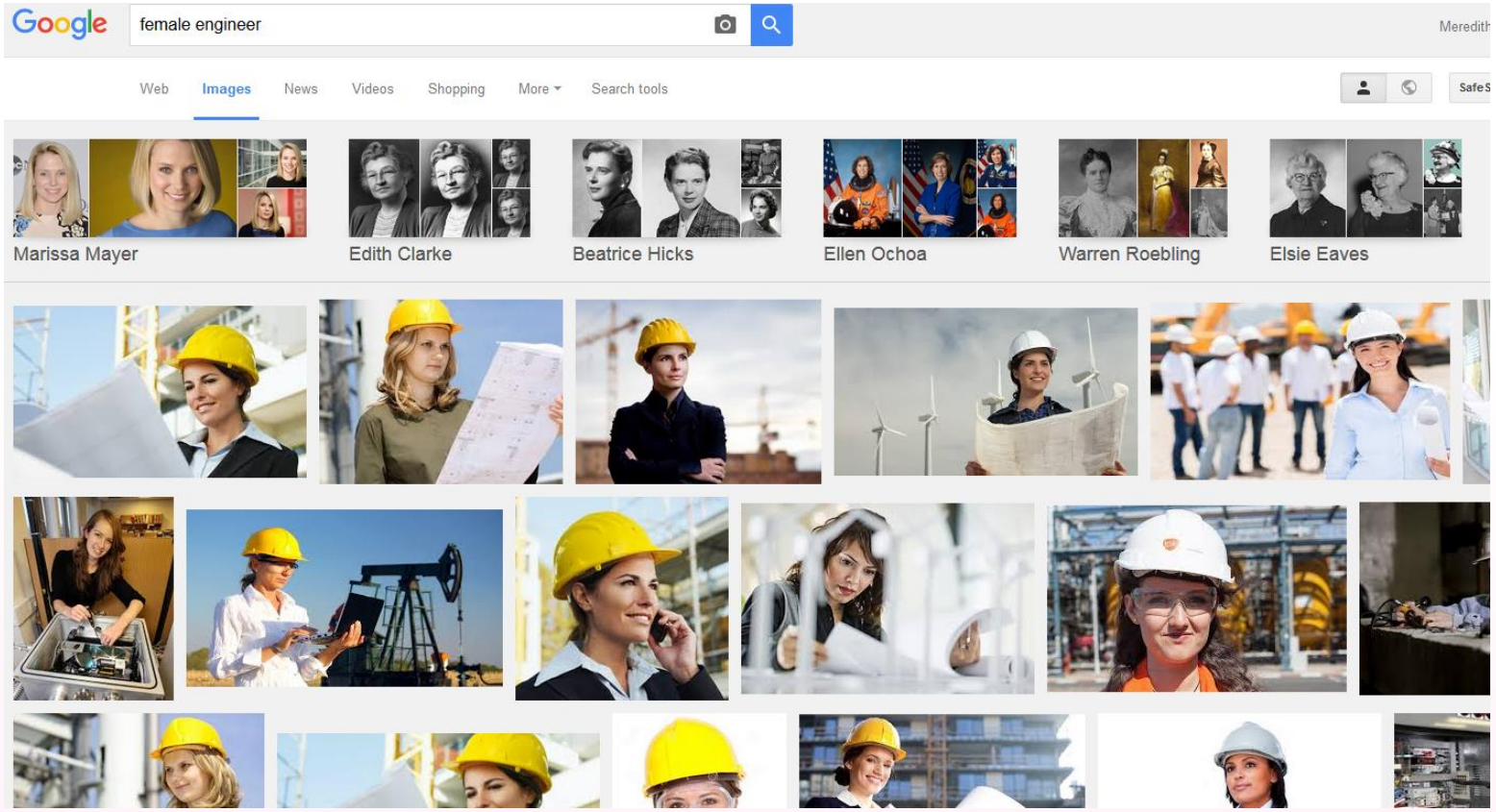
Past Girl Lab! Projects

- Homemade lip balm
- Make your own light bulbs
- Baking is Science
- Tower building competition
- Egg Drop
- Soap molds



Back Up

Google search: Female Engineer



Google Search: female scientist