Redesigning General Biology
Closing the Achievement Gap, Engaging Adjunct Faculty & Increasing Student Interest in STEM
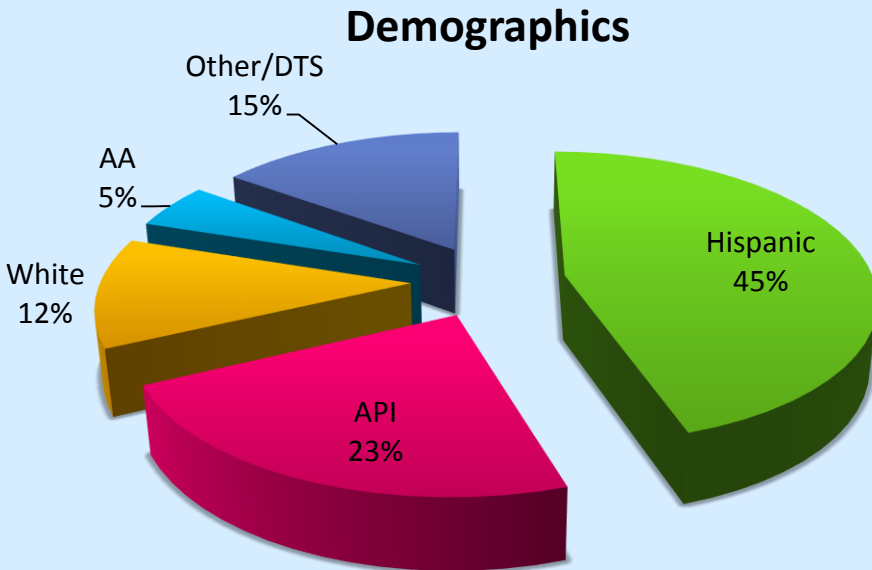
PASADENA CITY COLLEGE
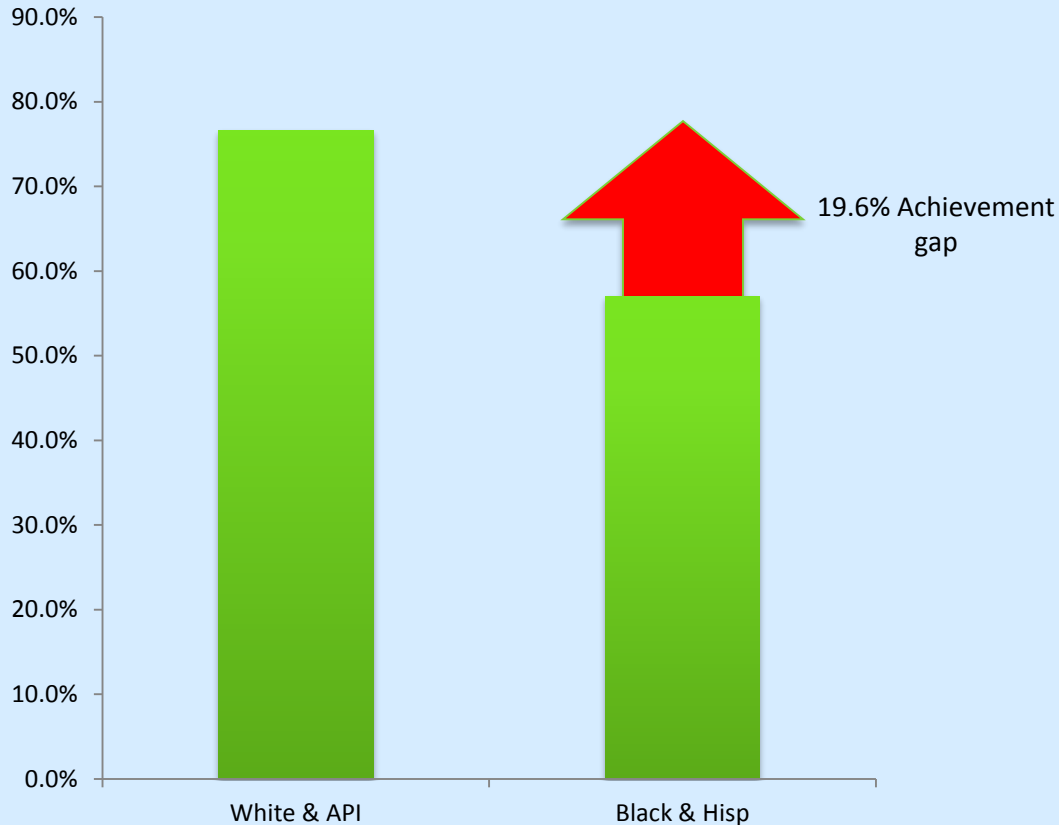
Lynn Wright – Director eSTEM, David Douglass – AVP, Katie Rodriguez - Faculty

Pasadena City College

- Urban 2-year community college

- Los Angeles metropolitan area

- Credit Enrollment: 26,500

Demographics

Other/DTS 15%
AA 5%
White 12%
API 23%
Hispanic 45%

The Challenge

Success in General Biology n ~ 8700

- Large achievement gaps are found throughout STEM courses

- PCAST work force data predicts we will fall short by a MILLION STEM graduates in the next decade

Four years of success rates in General Biology

"The study found that poor teaching was the most significant factor in explaining why 40-60% of students nationwide switched from STEM majors."
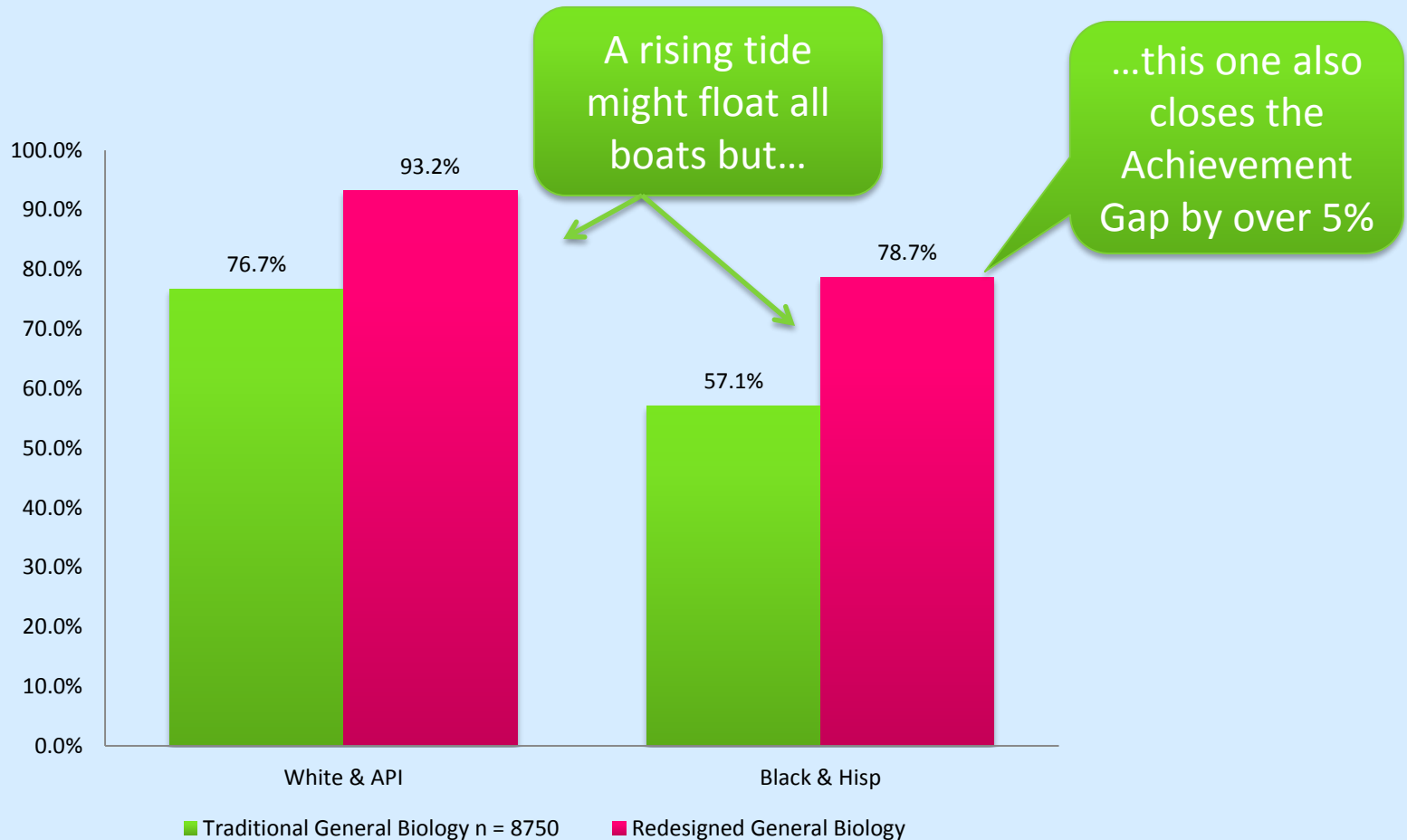

http://www.news.wisc.edu/21173

Redesign as a Response

Redesign Goals:

- Increase success and retention

- Increase scientific literacy

- Create more interest in STEM

- Imbed real-world skills

Key Elements to Redesign

- Contextualized content

- Scaffolded, problem-based learning

- Collaborative student work
  - Allows facilitated small-group instruction
  - Encourages peer bonding and interdependence

A TASTE OF REDESIGN
The Scientific Method

Outcome: Students will use the scientific method to solve problems

Traditional Week 1 Exercise

- *Worksheet packet*
  - Brief Lecture Introduction to the Scientific Method
  - Work through the packet in pairs
  - Submit your packet at the end of lab
  - Take a quiz

Redesign Week 1 Exercise

- *Black Box Exercise*
  - Brief intro to Scientific Method
  - Working in a team of 3-5 people
  - Nominate a team 'captain' and a 'recorder'
  - At the end your team will have 3 minutes to 'pitch' your experiment; winners receive a prize

Scaffolded Investigation: Getting Outside!

Field trip to local urban stream:

- Make and record observations
  - Keying
  - Role of invasive species
- Construct hypothesis on the impact of invasives
- Draft mini research paper
- Revise paper and present findings

Traditional Natural Selection Lab

Outcome: Students will use the scientific method to solve problems

Content: Natural Selection

In Lab

Students test forks and spoons to see which can pick up more beans

They collect data- how many beans are captured in a set time

At Home

Students individually create graphs

They write a brief report that includes:

- Introduction
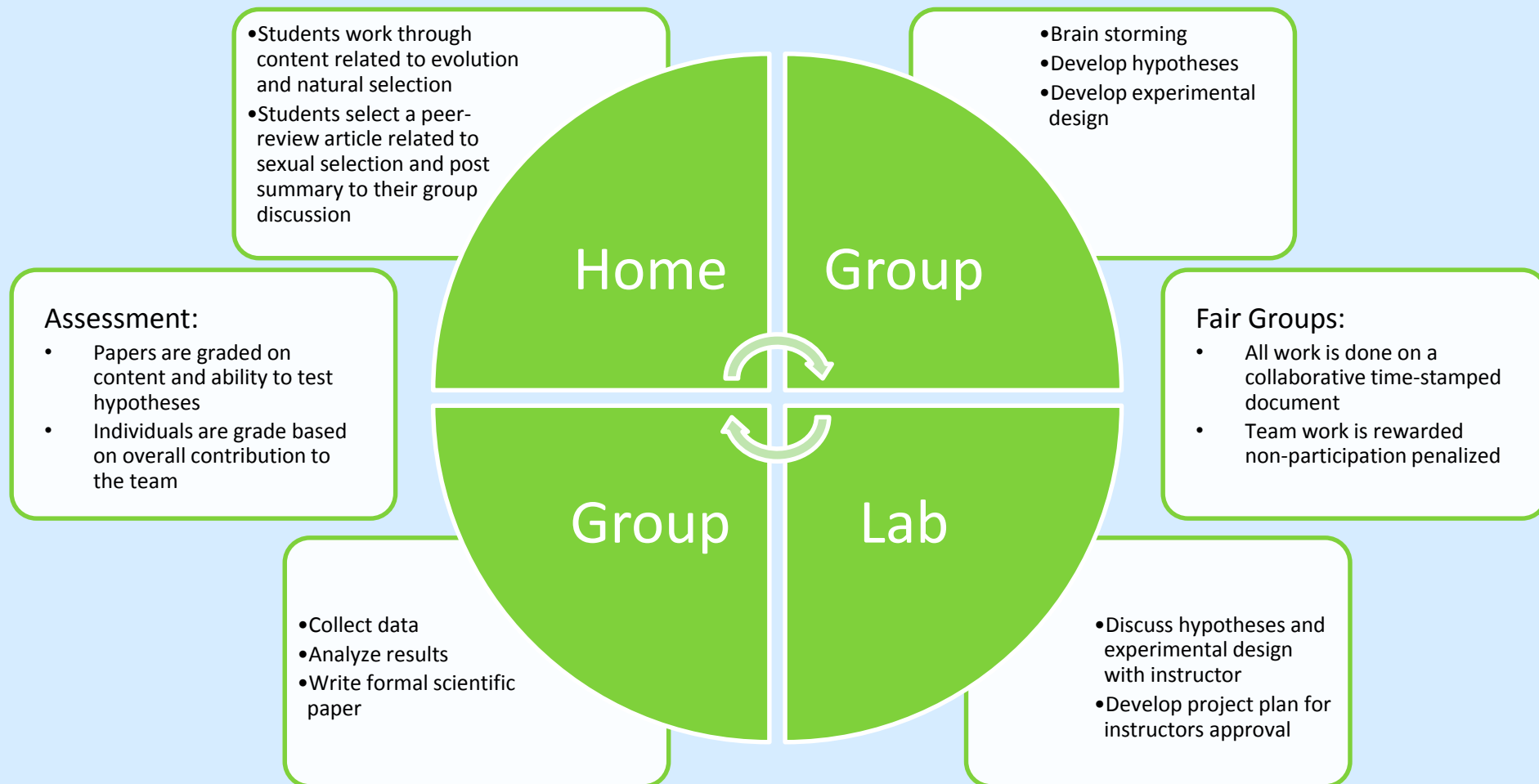- Materials and Methods
- Results
- Discussion

Assessment

Papers are graded for completeness

Redesigned Natural Selection Lab

Outcome: Students will use the scientific method to solve problems
Content: Natural Selection, Darwinian Fitness, Human Evolution, Sexual Reproduction

- Students work through content related to evolution and natural selection
- Students select a peer-review article related to sexual selection and post summary to their group discussion

- Brain storming
- Develop hypotheses
- Develop experimental design

Home

Group

Assessment:

- Papers are graded on content and ability to test hypotheses
- Individuals are grade based on overall contribution to the team

Fair Groups:

- All work is done on a collaborative time-stamped document
- Team work is rewarded non-participation penalized

Group

Lab

- Collect data
- Analyze results
- Write formal scientific paper

- Discuss hypotheses and experimental design with instructor
- Develop project plan for instructors approval
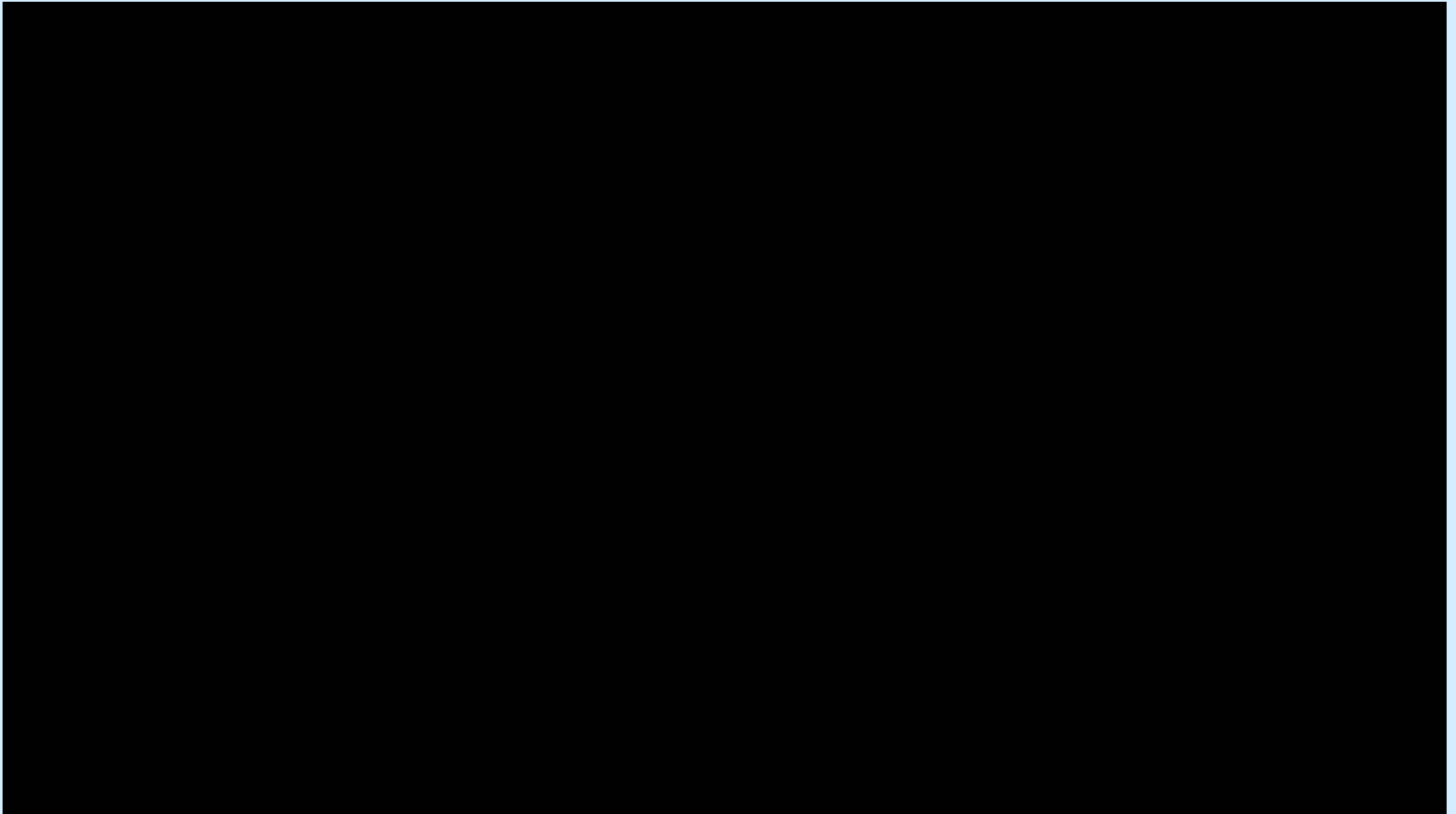
The Cap Stone – CSI PCC

The CSI Project

Students work in teams of 4-5 to solve a mock cold case over a 6 week period

- Analyze a diverse collection of evidence using:
  - Microscopy
  - Gel electrophoresis
  - Chemical analyses
  - Scene/timeline reconstruction
- Maintain a detailed lab notebook
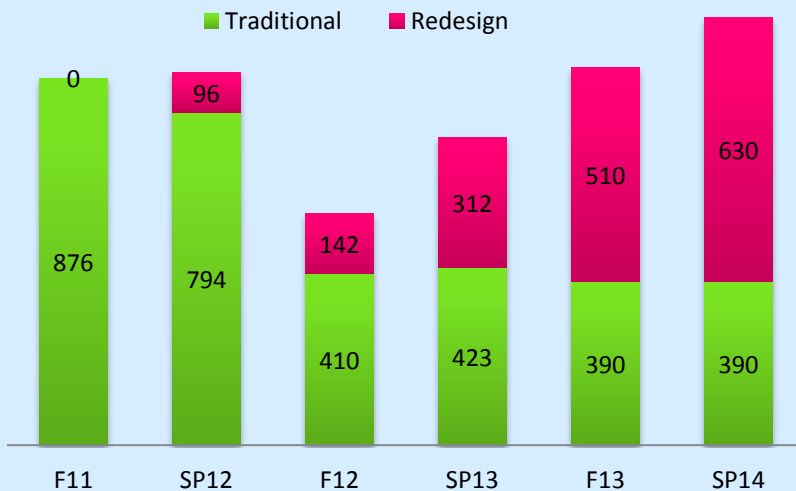- Create & present a comprehensive argument supported by data

#PCCBIO11 – The Role of Social Media

Implementing and Scaling Redesign

General Biology
Students Starting

Chart: Students Starting — General Biology

Legend: Traditional (green), Redesign (pink)

Term	Traditional	Redesign
F11	876	0
SP12	794	96
F12	410	142
SP13	423	312
F13	390	510
SP14	390	630

Collateral Benefits

- Increased student interest in majoring in STEM
- Faculty development - Community of practice
  - Support to new and senior faculty
  - Continuous cycle of improvement
    - Course <u>and</u> instructors

Closing the Achievement Gap*
Grades

F 12 - SP 13 HISPANIC (%)

*significant
χ^2 test
p<0.0001
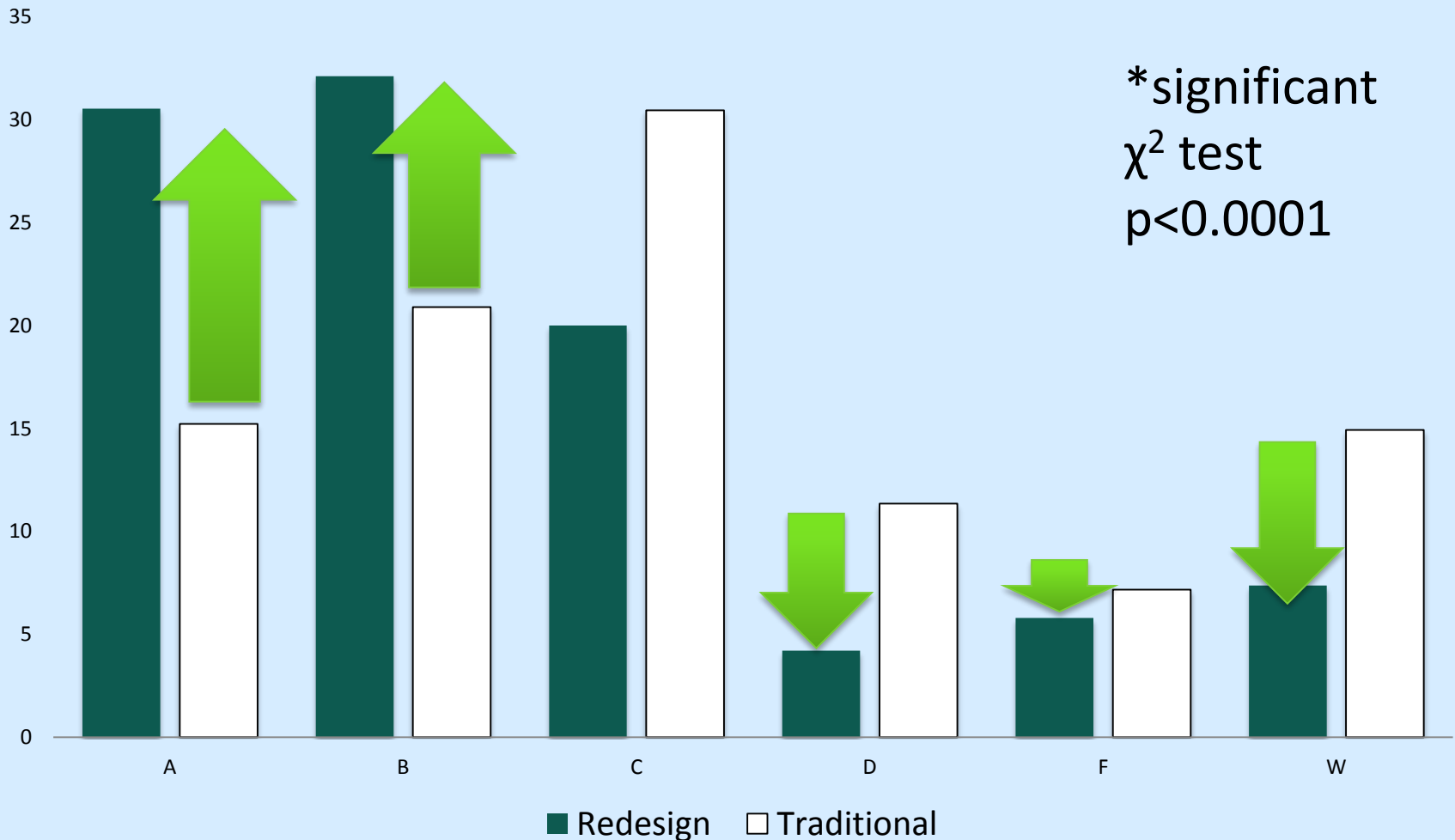
Additional Benefits of Redesign for Students

- Students taking the redesigned course were ***16% more likely*** to remain enrolled in subsequent semesters

- Increased interest in STEM among general education students

- Enhanced relationship between instructors and their students (mentoring)

- Made science a lot more fun and engaging!

Next Steps

- Expanding this course redesign model beyond General Biology – Next Victim: Chemistry!

- Targeted recruitment into STEM

- Building on our community of practice

QUESTIONS
FOUND IN GOOGLE AUTOCOMPLETE

WHY DO WHALES JUMP
WHY ARE WITCHES GREEN
WHY ARE THERE MIRRORS ABOVE BEDS
WHY DO I SAY UH
WHY IS SEA SALT BETTER
WHY ARE THERE TREES IN THE MIDDLE OF FIELDS
WHY IS THERE NOT A POKEMON MMO
WHY IS THERE LAUGHING IN TV SHOWS
WHY ARE THERE DOORS ON THE FREEWAY
WHY ARE THERE SO MANY SVCHOST.EXE RUNNING
WHY AREN'T THERE ANY COUNTRIES IN ANTARCTICA
WHY ARE THERE SCARY SOUNDS IN MINECRAFT
WHY IS THERE KICKING IN MY STOMACH
WHY ARE THERE TWO SLASHES AFTER HTTP
WHY ARE THERE CELEBRITIES
WHY DO SNAKES EXIST
WHY DO OYSTERS HAVE PEARLS
WHY ARE DUCKS CALLED DUCKS
WHY DO THEY CALL IT THE CLAP
WHY ARE KYLE AND CARTMAN FRIENDS
WHY IS THERE AN ARROW ON AANG'S HEAD
WHY ARE TEXT MESSAGES BLUE
WHY ARE THERE MUSTACHES ON CLOTHES
WHY ARE THERE MUSTACHES ON CARS
WHY ARE THERE MUSTACHES EVERYWHERE
WHY ARE THERE SO MANY BIRDS IN OHIO
WHY IS THERE SO MUCH RAIN IN OHIO
WHY IS OHIO WEATHER SO WEIRD
WHY ARE THERE MALE AND FEMALE BIKES
WHY ARE THERE BRIDESMAIDS
WHY DO DYING PEOPLE REACH UP
WHY AREN'T THERE VARICOSE ARTERIES
WHY ARE OLD KLINGONS DIFFERENT
WHY ARE THERE SQUIRRELS
WHY IS PROGRAMMING SO HARD
WHY IS THERE A 0 OHM RESISTOR
WHY DO AMERICANS HATE SOCCER
WHY DO RHYMES SOUND GOOD
WHY DO TREES DIE
WHY IS THERE NO SOUND ON CNN
WHY AREN'T POKEMON REAL
WHY AREN'T BULLETS SHARP
WHY DO DREAMS SEEM SO REAL

WHY AREN'T THERE
WHY DO IGUANAS DIE
WHY AREN'T THERE TREES TALL
WHY DO TESTICLES MOVE
WHY ARE THERE PSYCHICS
WHY ARE HATS SO EXPENSIVE
WHY IS THERE CAFFEINE IN MY SHAMPOO
WHY DO YOUR BOOBS HURT
DINOSAUR GHOSTS
WHY IS THERE HELL IF GOD FORGIVES

WHY ARE THERE FEMALE MR MIMES
WHY IS GPS FREE

WHY AREN'T ECONOMISTS RICH
WHY DO AMERICANS CALL IT SOCCER
WHY ARE MY EARS RINGING
WHY ARE THERE SO MANY AVENGERS
WHY ARE THE AVENGERS FIGHTING THE X MEN
WHY IS WOLVERINE NOT IN THE AVENGERS
WHY ARE THERE ANTS IN MY LAPTOP
WHY IS EARTH TILTED
WHY IS SPACE BLACK
WHY IS OUTER SPACE SO COLD
WHY ARE THERE PYRAMIDS ON THE MOON
WHY IS NASA SHUTTING DOWN

WHY ARE THERE
GHOSTS

WHY IS SEX
SO IMPORTANT

WHY IS MT VESUVIUS THERE
WHY DO THEY SAY T MINUS
WHY ARE THERE OBELISKS
WHY ARE WRESTLERS ALWAYS WET
WHY ARE OCEANS BECOMING MORE ACIDIC
WHY IS ARWEN DYING
WHY AREN'T MY QUAIL LAYING EGGS
WHY AREN'T MY QUAIL EGGS HATCHING
WHY AREN'T THERE ANY FOREIGN MILITARY BASES IN AMERICA

WHY IS THERE LAVA

WHY ARE THERE SLAVES IN THE BIBLE
WHY DO TWINS HAVE DIFFERENT FINGERPRINTS
WHY ARE AMERICANS AFRAID OF DRAGONS
WHY ARE TREES TALL
WHY IS HTTPS CROSSED OUT IN RED
WHY IS THERE A LINE THROUGH HTTPS
WHY IS THERE A RED LINE THROUGH HTTPS ON FACEBOOK
WHY IS HTTPS IMPORTANT
WHY IS YKK ON ALL ZIPPERS
WHY AREN'T MY ARMS GROWING
WHY ARE THERE WEEKS
WHY DO I FEEL DIZZY
WHY ARE THERE SWARMS OF GNATS
WHY IS THERE PHLEGM
WHY ARE THERE SO MANY CROWS IN ROCHESTER, MN
WHY IS PSYCHIC WEAK TO BUG
WHY DO CHILDREN GET CANCER
WHY IS POSEIDON ANGRY WITH ODYSSEUS
WHY IS THERE ICE IN SPACE
WHY IS THERE AN OWL IN MY BACKYARD
WHY IS THERE AN OWL OUTSIDE MY WINDOW
WHY IS THERE AN OWL ON THE DOLLAR BILL
WHY DO OWLS ATTACK PEOPLE
WHY ARE AK 47s SO EXPENSIVE
WHY ARE THERE HELICOPTERS CIRCLING MY HOUSE
WHY ARE THERE GODS
WHY ARE THERE TWO SPOCKS
WHY ARE MY BOOBS ITCHY
WHY ARE CIGARETTES LEGAL
WHY ARE THERE DUCKS IN MY POOL
WHY IS JESUS WHITE
WHY IS THERE LIQUID IN MY EAR
WHY DO Q TIPS FEEL GOOD
WHY DO GOOD PEOPLE DIE

WHY IS LIFE SO BORING

WHY ARE DOGS AFRAID OF FIREWORKS
WHY IS THERE NO KING IN ENGLAND

WHY AREN'T THERE GUNS IN HARRY POTTER
WHY ARE ULTRASOUNDS IMPORTANT
WHY ARE ULTRASOUND MACHINES EXPENSIVE
WHY IS STEALING WRONG

WHY IS THERE TINY SPIDERS IN MY HOUSE
WHY DO SPIDERS COME INSIDE
WHY ARE THERE HUGE SPIDERS IN MY HOUSE
WHY ARE THERE LOTS OF SPIDERS IN MY HOUSE
WHY ARE THERE SPIDERS IN MY ROOM
WHY ARE THERE SO MANY SPIDERS IN MY ROOM
WHY DO SPIDER BITES ITCH
WHY IS DYING SO SCARY
WHY IS THERE NO GPS IN LAPTOPS
WHY DO KNEES CLICK
WHY AREN'T THERE E GRADES
WHY IS ISOLATION BAD
WHY DO BOYS LIKE ME
WHY DON'T BOYS LIKE ME
WHY IS THERE ALWAYS A JAVA UPDATE
WHY ARE THERE RED DOTS ON MY THIGHS
WHY IS LYING GOOD

Thank You!

- Want to find out more?
  - Instagram and Twitter #PCCBIO11

Stats for Data Geeks

```
61 . xtgee retention_rate i.group_r i.type_r i.type_r#group_r c.academic_period, family(binomial) lin
> k(probit) eform

Iteration 1: tolerance =   .00175334
Iteration 2: tolerance =   .00001873
Iteration 3: tolerance =   2.110e-07
```

GEE population-averaged model		Number of obs =	24060
Group variable:	id	Number of groups =	10972
Link:	probit	Obs per group: min =	2
Family:	binomial	avg =	2.2
Correlation:	exchangeable	max =	8
		Wald chi2(4) =	216.28
Scale parameter:	1	Prob > chi2 =	0.0000

retention_rate	exp(b)	Std. Err.	z	P>|z|	[95% Conf. Interval]	
group_r 2 - TREATMENT	1.158701	.0806374	2.12	0.034	1.01096	1.328034
type_r 2 - POST	.8593532	.015138	-8.60	0.000	.8301897	.8895412
type_r#group_r 2 - POST#2 - TREATMENT	.876304	.0771663	-1.50	0.134	.737393	1.041383
academic period	1.028111	.002765	10.31	0.000	1.022706	1.033544
_cons	1.846858	.0391413	28.95	0.000	1.771714	1.925189

More Stats for Data Geeks

```
GEE population-averaged model          Number of obs      =        24058
Group variable:                    id   Number of groups   =        10971
Link:                          probit   Obs per group: min =            2
Family:                      binomial                  avg =          2.2
Correlation:              exchangeable                  max =            8
                                        Wald chi2(8)       =       593.08
Scale parameter:                    1   Prob > chi2        =       0.0000
```

success_rate	exp(b)	Std. Err.	z	P>|z|	[95% Conf. Interval]	
group_r						
2 - TREATMENT	2.42942	.1722653	12.52	0.000	2.114198	2.791641
type_r						
2 - POST	.8822312	.0099372	-11.12	0.000	.8629682	.9019243
type_r#group_r						
2 - POST#2 - TREATMENT	.7404636	.0475719	-4.68	0.000	.652856	.8398275
prim ethnicity category desc r						
Asian or Pacific Islander	1.656979	.3386691	2.47	0.013	1.110044	2.473396
Black Non-Hispanic	.8772059	.1848399	-0.62	0.534	.5804182	1.325751
Hispanic	1.108659	.2267556	0.50	0.614	.742507	1.655371
Other	1.49455	.3087865	1.94	0.052	.9968846	2.240659
White Non-Hispanic	1.407047	.2893257	1.66	0.097	.940328	2.105416
_cons	1.176116	.2395695	0.80	0.426	.7889771	1.753219