Curriculum development efforts for an inquiry-based introductory lab course or can we have it all?

Ayce Yesilaltay

MIT DEPARTMENT OF BIOLOGY

The 7.02 Teaching Team

in alphabetical order

Instructors in Lab:

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Ayce Yesilaltay

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Piyush Gupta
Thomas Schwartz
Dane Wittrup

Writing Instructors:

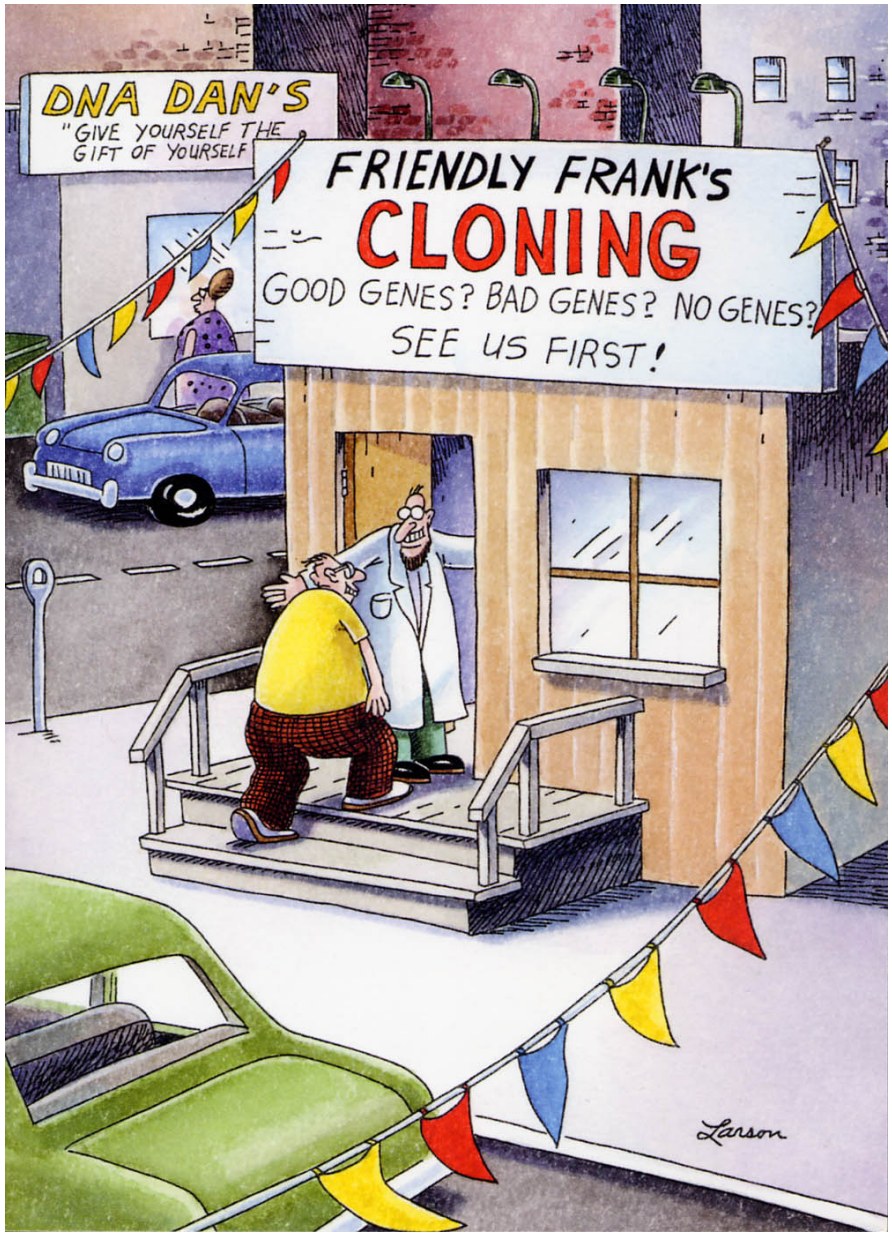
Amelia Herb
Jane Kokernak
Marilee Ogren-Balkema
Leslie Roldan

Lab Manager:

Anthony Fuccione

Graduate and undergraduate TAs

Genes and Genetics: what's not to like?



Outline

- Introduction to 7.02
- Challenges
- Development of the new curriculum
- Assessment

What is 7.02?

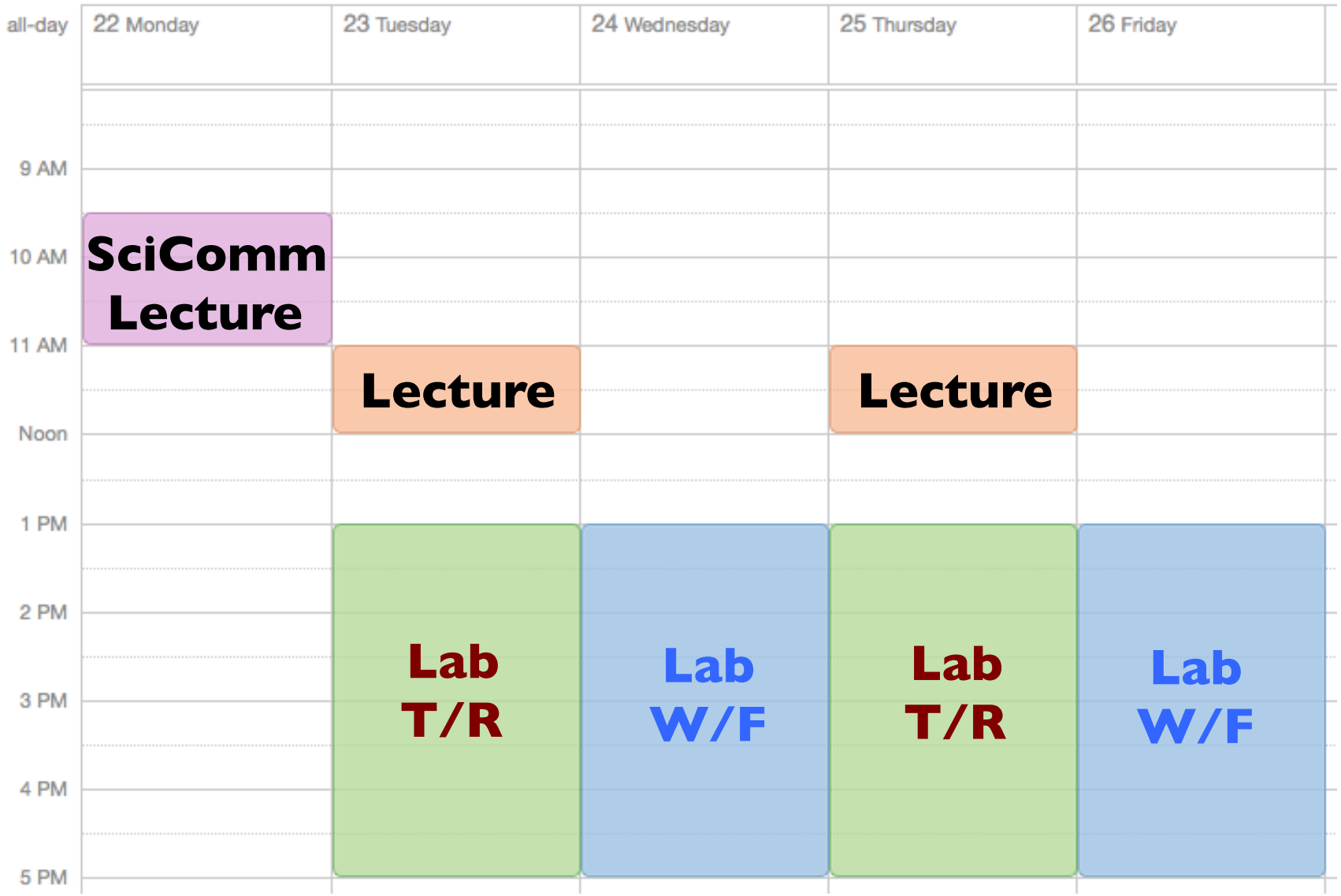
Introduction to Experimental Biology and Scientific Communication

- 18-unit introductory lab course
- Communications-intensive
- Prerequisite: 7.01x (Introductory Biology)
- Geared towards sophomores
- Enrollment: 110-130 students per year

Learning goals in 7.02

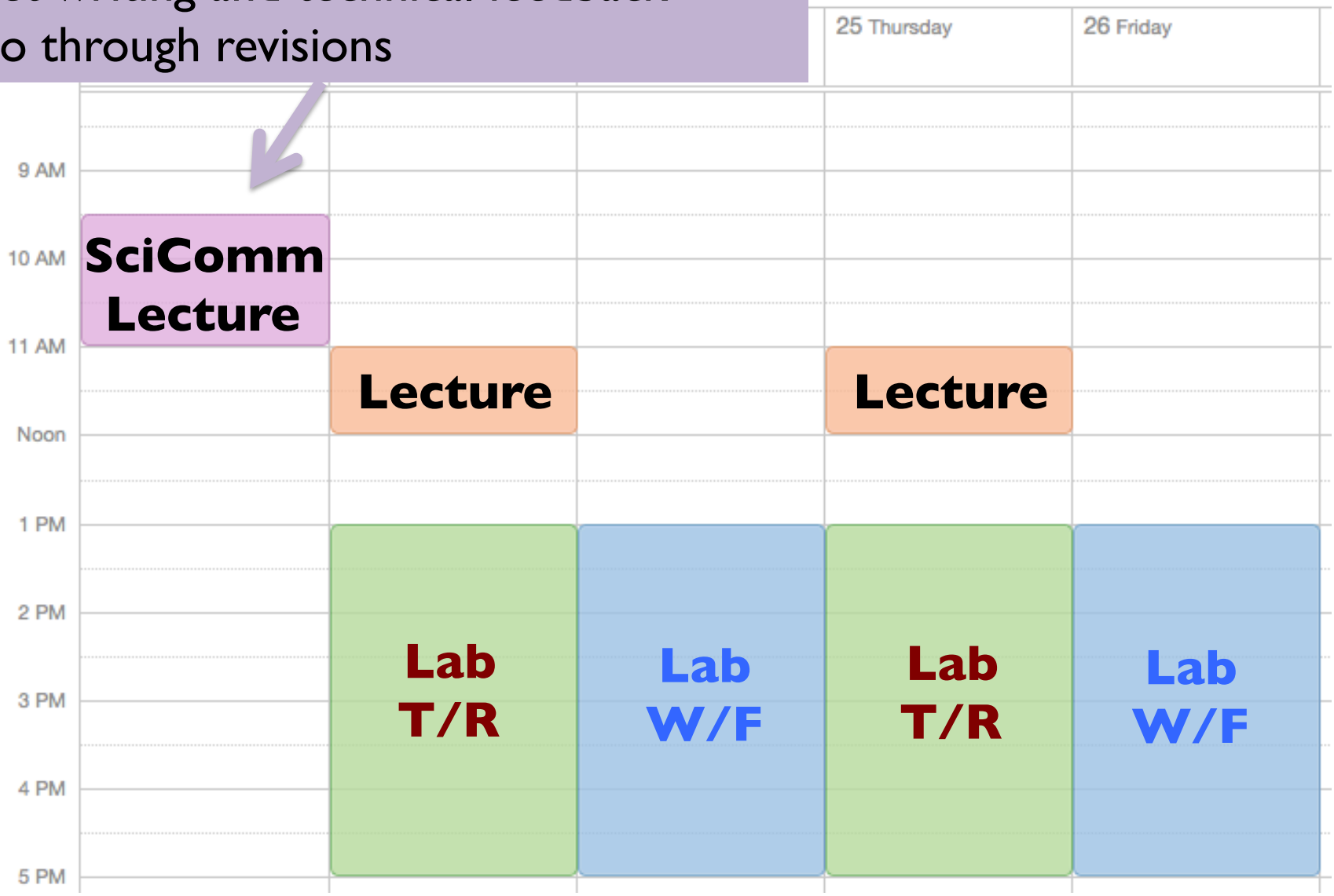
- Experimental techniques
  - Practice
  - Theory
  - Troubleshooting
  - Writing a lab notebook
- Data analysis
- Scientific communication
- Experimental design

Ways to learn in 7.02



Write a manuscript on their own work
Get writing and technical feedback
Go through revisions

in 7.02



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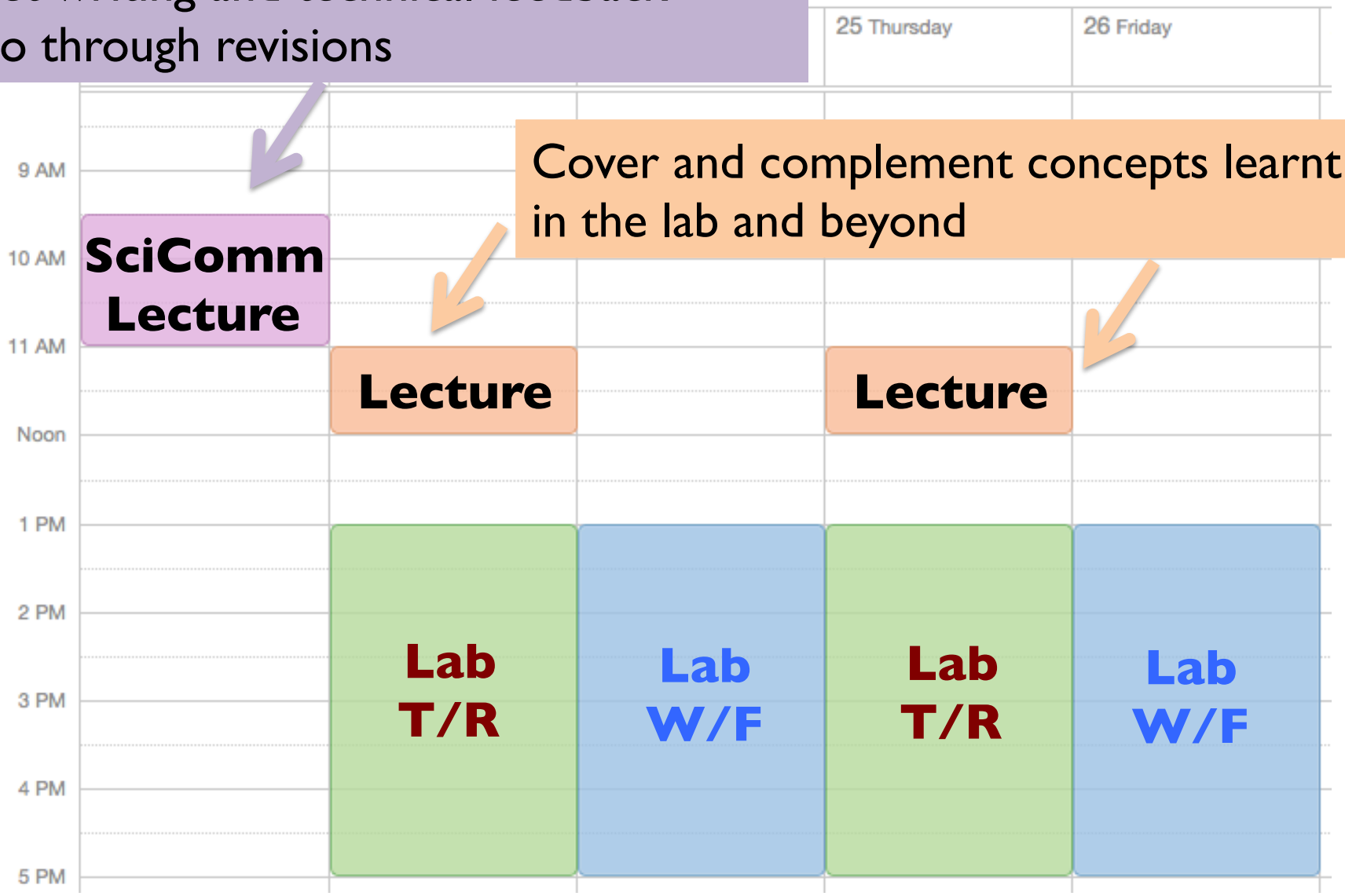
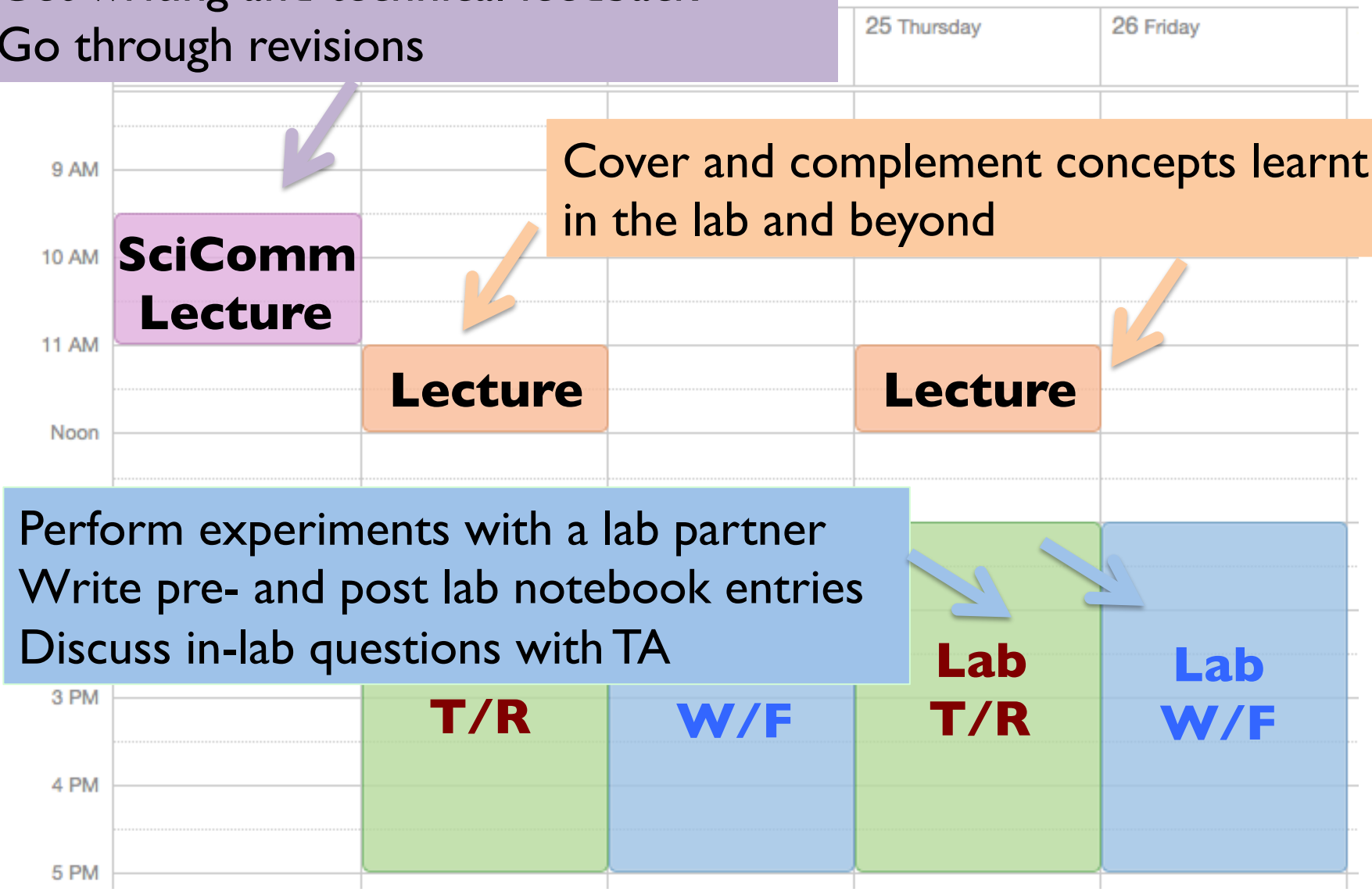


Cover and complement concepts learnt in the lab and beyond

in 7.02

Write a manuscript on their own work
Get writing and technical feedback
Go through revisions



Cover and complement concepts learnt in the lab and beyond

Perform experiments with a lab partner
Write pre- and post lab notebook entries
Discuss in-lab questions with TA

T/R

W/F

The Three Modules of 7.02

Biochemistry (10 lab days)	Chemical Eng. (4 lab days)	Genetics (10 lab days)
Mutagenesis	Yeast surface display	Genetic screens
Protein expression		Recombination
Protein purification		Complementation
Functional assays		Genetic interactions

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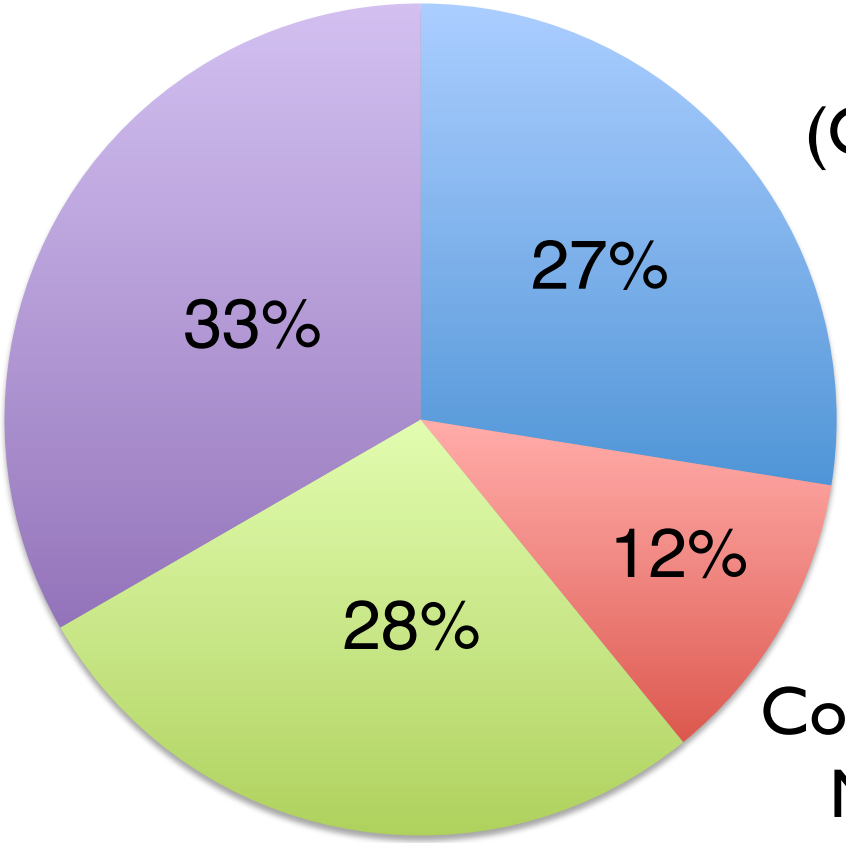
Challenges? What challenges?

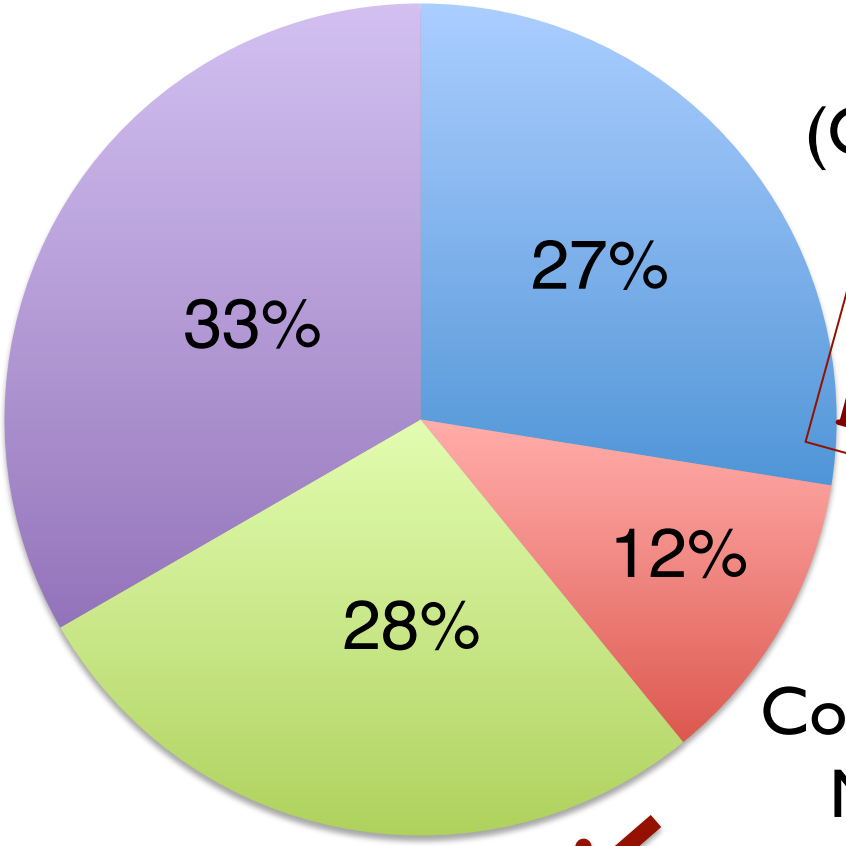
Who takes 7.02?

Distribution of majors in 7.02



According to currently preregistered students for Fall 2014

Distribution of majors in 7.02



Biology (Course 7)

GRADUATION REQUIREMENT

Computer Science and Molecular Biology (Course 6/7)

Chemical Biological Engineering (Course 10B)

Other

According to currently preregistered students for Fall 2014

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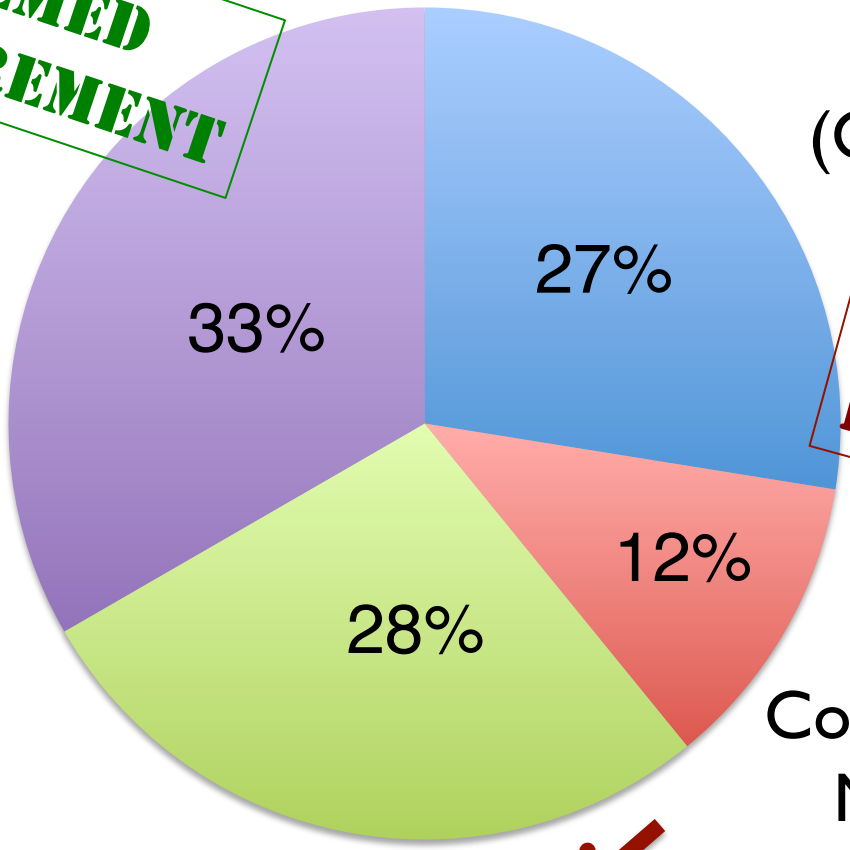


PREMED REQUIREMENT

Other

Biology (Course 7)

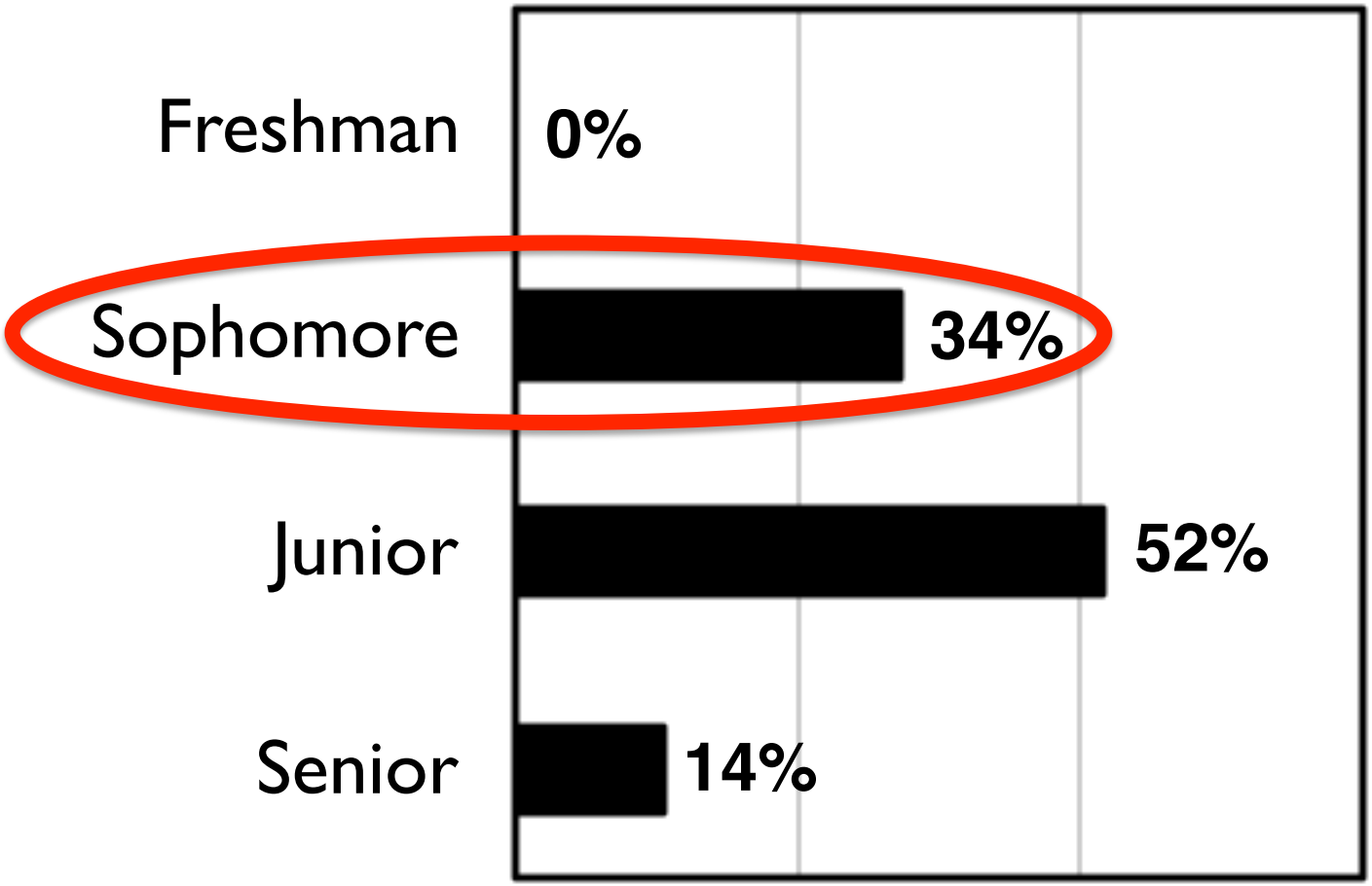
GRADUATION REQUIREMENT

Computer Science and Molecular Biology (Course 6/7)

Chemical Biological Engineering (Course 10B)

According to currently preregistered students for Fall 2014

Which year students take 7.02?



According to currently preregistered students for Fall 2014

Challenges recapped

Preparing content for a mixed student population

- Different majors
- Different years
- Vastly varied lab experience
- Different goals and expectations

Outline

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From worm genetics to yeast genetics

What do the students think?

Considerations for the new module

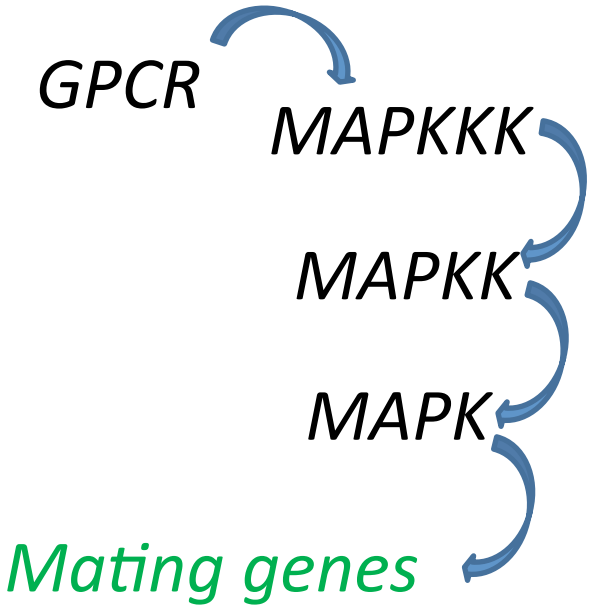
- Build the course around the genetics concepts required for the students
- Design a cohesive, hypothesis-driven module with an overarching goal
- Involve students in the decision-making process
- Potential for new research findings

The topic?

The yeast mating pathway

Why do we care about yeast mating?

Signal transduction is conserved



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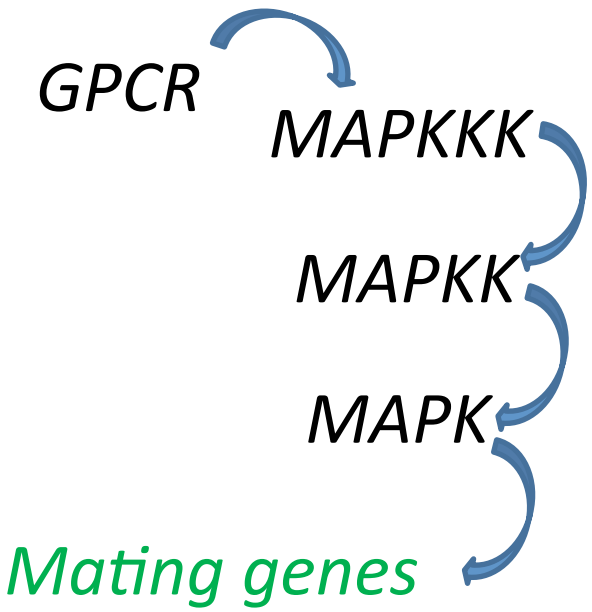

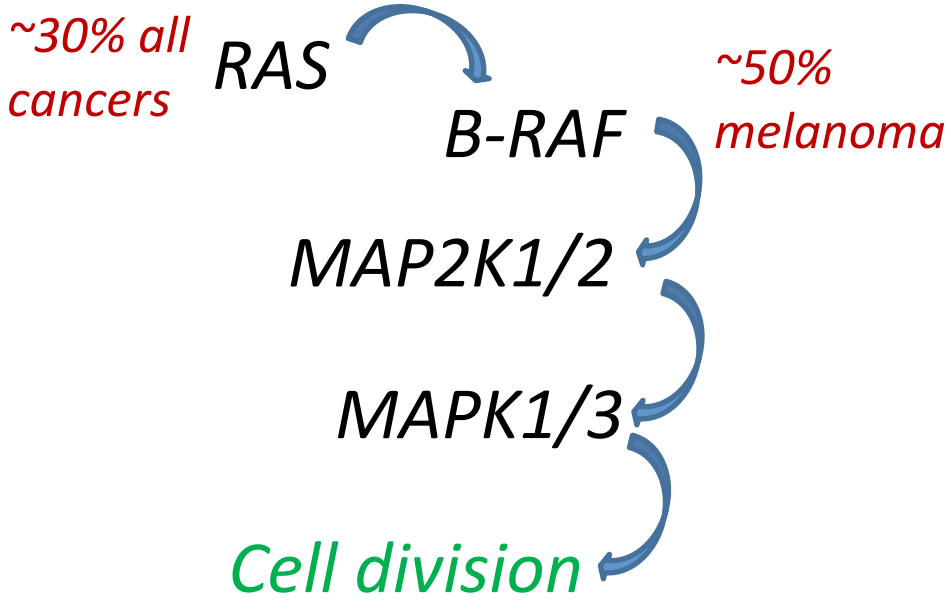

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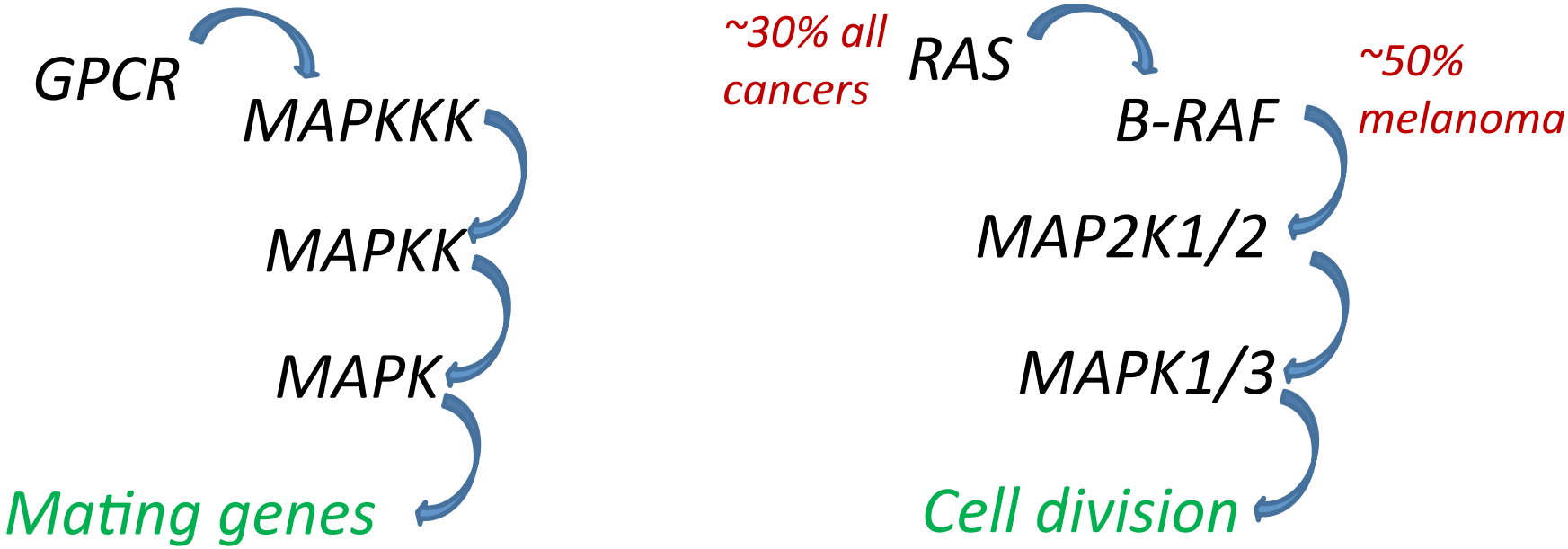
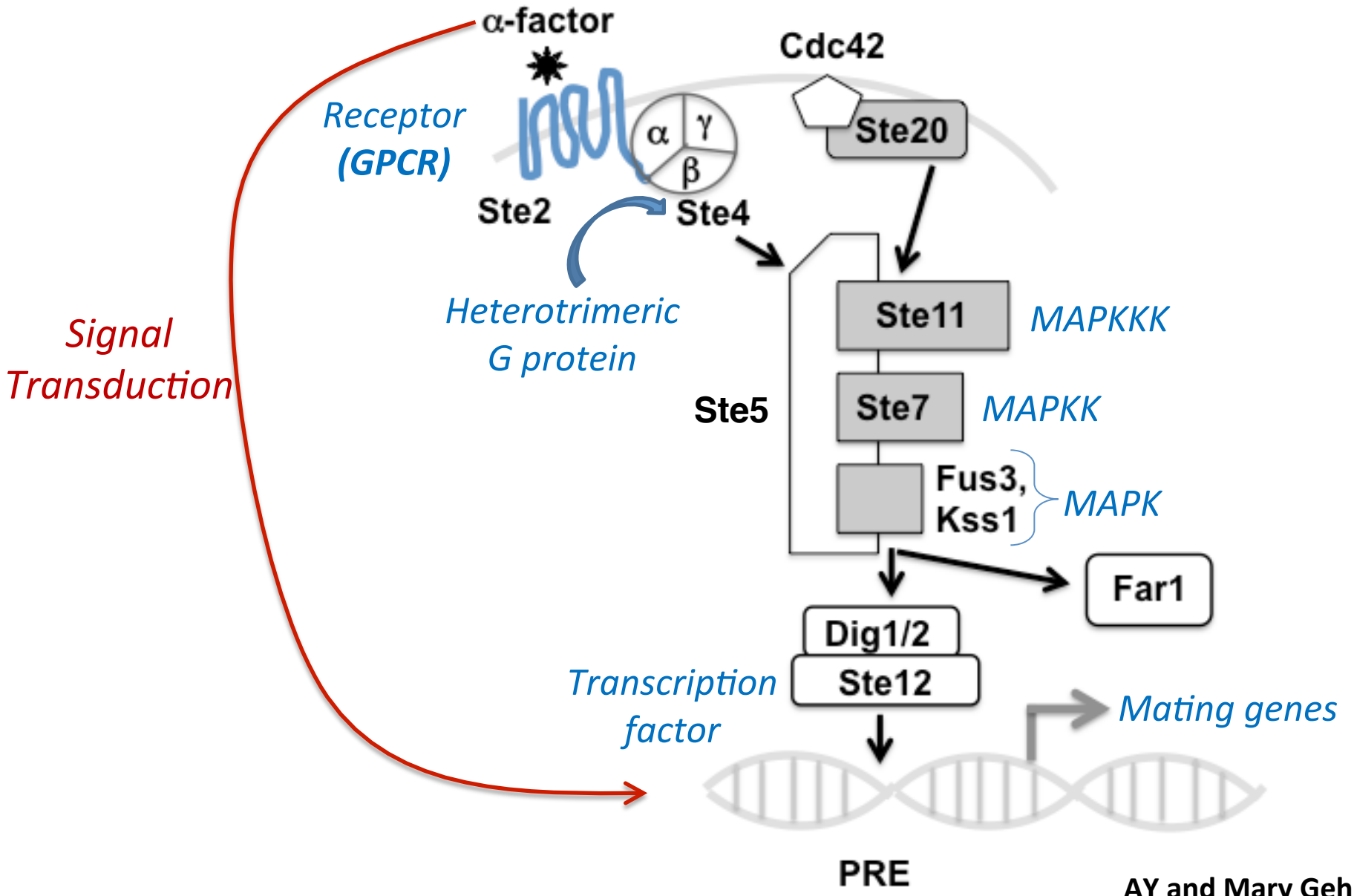


Most oncogenes are mutated kinases

Many cancer drugs target kinases

Piyush Gupta

Yeast mating signal transduction pathway



AY and Mary Gehring

The new genetics module

Generate transposon-mutagenized yeast library

↓

Select mutants defective in response to mating factor α-factor

↓

Perform three assays to confirm the mutant phenotype

↓

Identify the mutants by plasmid rescue, sequencing and BLAST

The new genetics module

Generation of new unique reagents

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Decision making

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The new genetics module

Generation of new unique reagents

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Decision making

Select mutants defective in response to mating factor α-factor

Decision making

Perform three assays to confirm the mutant phenotype

Potential for identification of new genes

Identify the mutants by plasmid rescue, sequencing and BLAST

Genes identified by the class
(and the number of times they were identified)

New gene implicated for the first time in the yeast mating pathway!

STE2
STE5 (2)
STE6
STE7 (2)
SIR3, aka STE8 (2)
SIR4, aka STE9 (3)
KCC4 (3)
TAR1 (2)
BEM4
FUS2
CLB6

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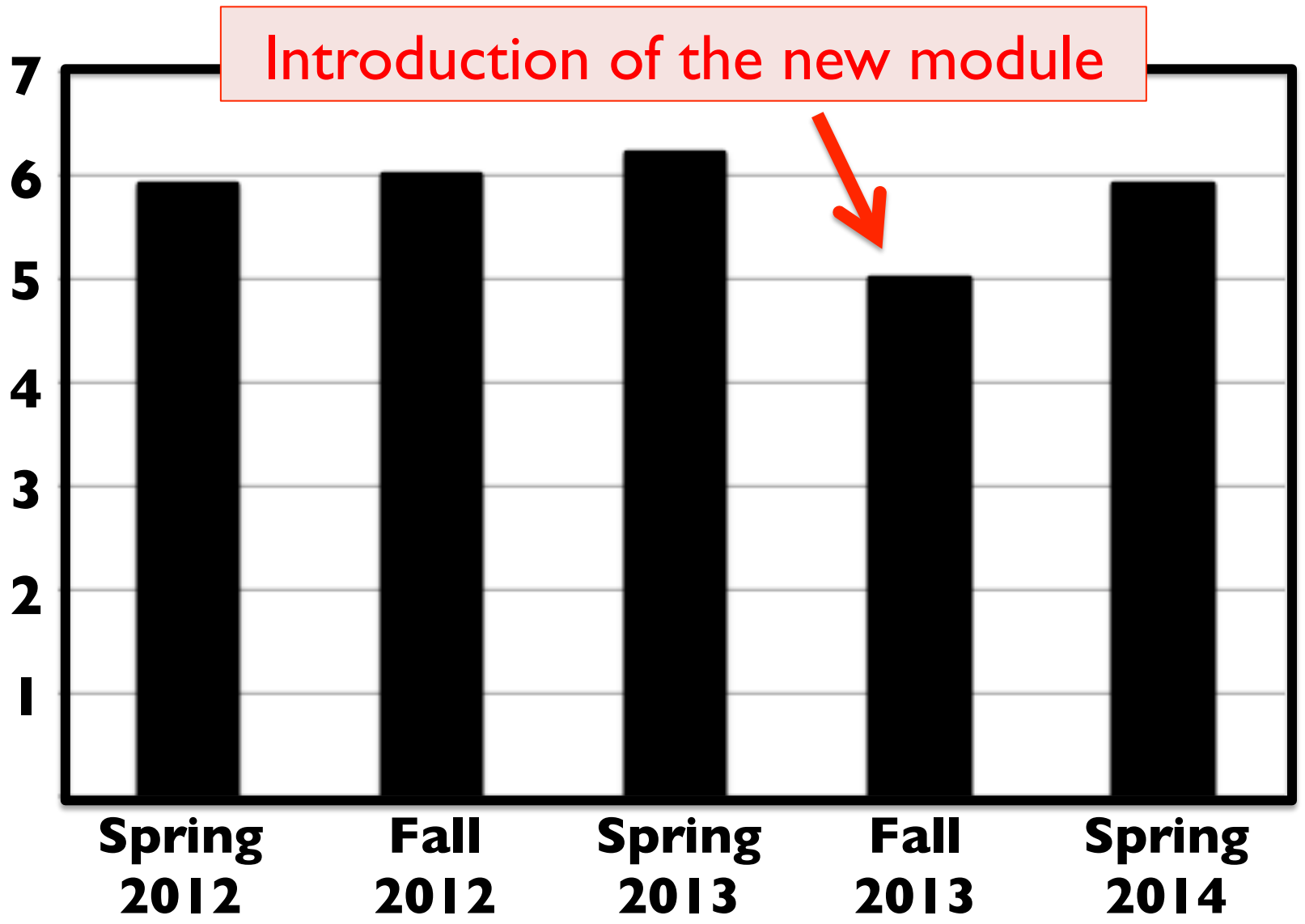
Students' subject evaluation of 7.02 (out of 7)



Paper evaluations vs online evaluations

- Higher rate of response
- More detailed feedback
- Ability to ask open-ended questions
- Ability to administer self-assessment questionnaire

What was your least favorite part of the Genetics Module?

Fall 2013

"Long lab days"

"Broken pipettes"

"Not enough spectrophotometers"

What was your least favorite part of the Genetics Module?

Fall 2013

"Long lab days"

"Broken pipettes"

"Not enough spectrophotometers"

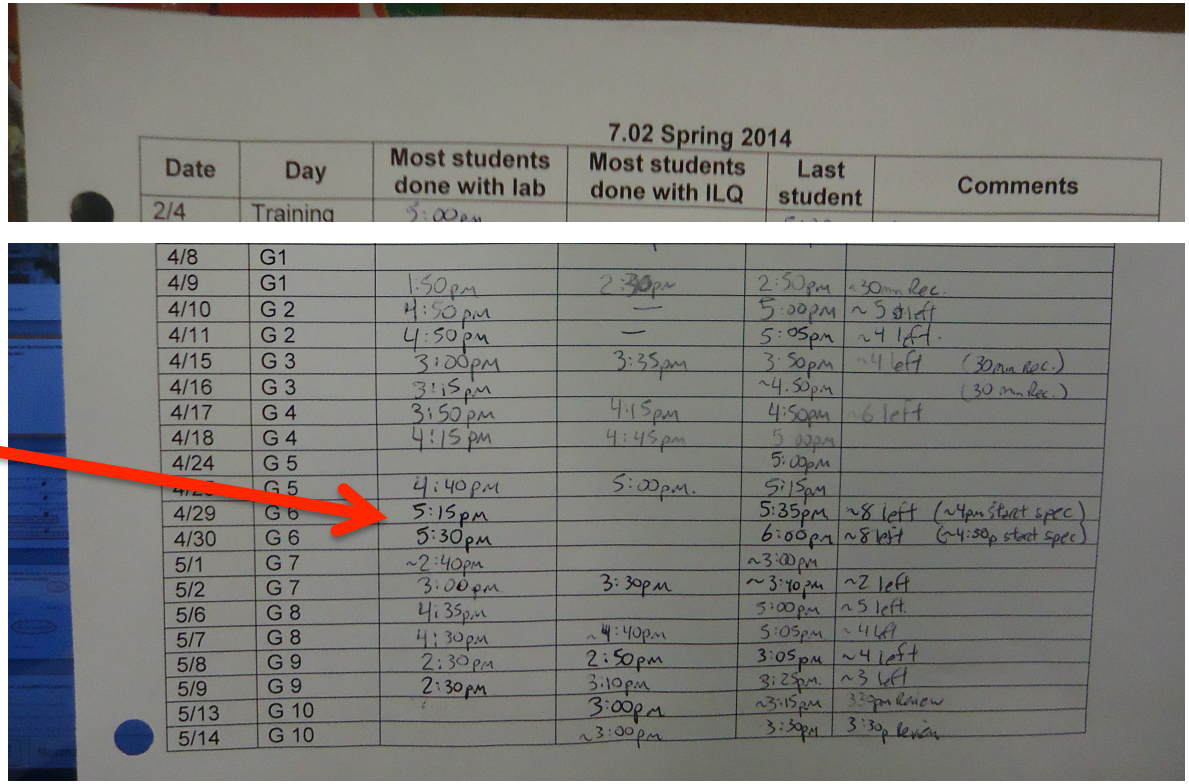
→ These issues were addressed for the Spring 2014 semester

Broken pipettes?

What was your least favorite part of the Genetics Module?

Spring 2014

"That one long lab day!"



7.02 Spring 2014

Date	Day	Most students done with lab	Most students done with ILQ	Last student	Comments
2/4	Training	3:00pm			
4/8	G1				
4/9	G1	1:50pm	2:30pm	2:50pm	~30mm Rec.
4/10	G 2	4:50pm	—	5:00pm	~5 left
4/11	G 2	4:50pm	—	5:05pm	~4 left.
4/15	G 3	3:00pm	3:35pm	3:50pm	~4 left (30mm Rec.)
4/16	G 3	3:15pm		~4.50pm	(30 mm Rec.)
4/17	G 4	3:50pm	4:15pm	4:50pm	~6 left
4/18	G 4	4:15pm	4:45pm	5:00pm	
4/24	G 5			5:00pm	
[illegible]	G 5	4:40pm	5:00p.m.	5:15pm	
4/29	G 6	5:15pm		5:35pm	~8 left (~4pm start spec)
4/30	G 6	5:30pm		6:00pm	~8 left (~4:50p start spec)
5/1	G 7	~2:40pm		~3:00pm	
5/2	G 7	3:00pm	3:30pm	~3:40pm	~2 left
5/6	G 8	4:35pm		5:00pm	~5 left.
5/7	G 8	4:30pm	~4:40pm	5:05pm	~4 left
5/8	G 9	2:30pm	2:50pm	3:05pm	~4 left
5/9	G 9	2:30pm	3:10pm	3:25pm	~3 left
5/13	G 10		3:00pm	~3:15pm	3:3pm Review
5/14	G 10		~3:00pm	3:30pm	3:30p Review

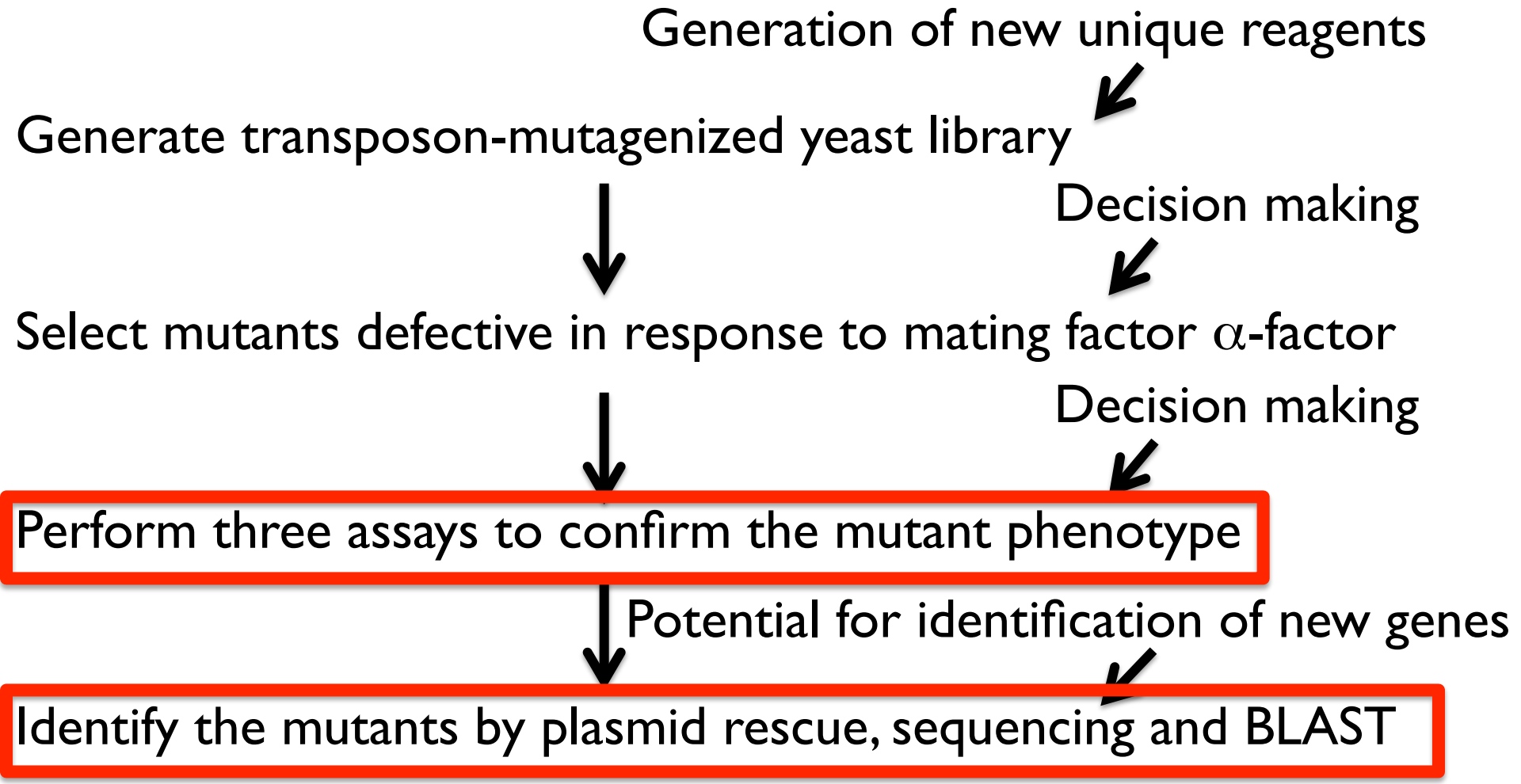
What was your favorite part of the Genetics Module?
Fall 2013 and Spring 2014

"The functional assays"

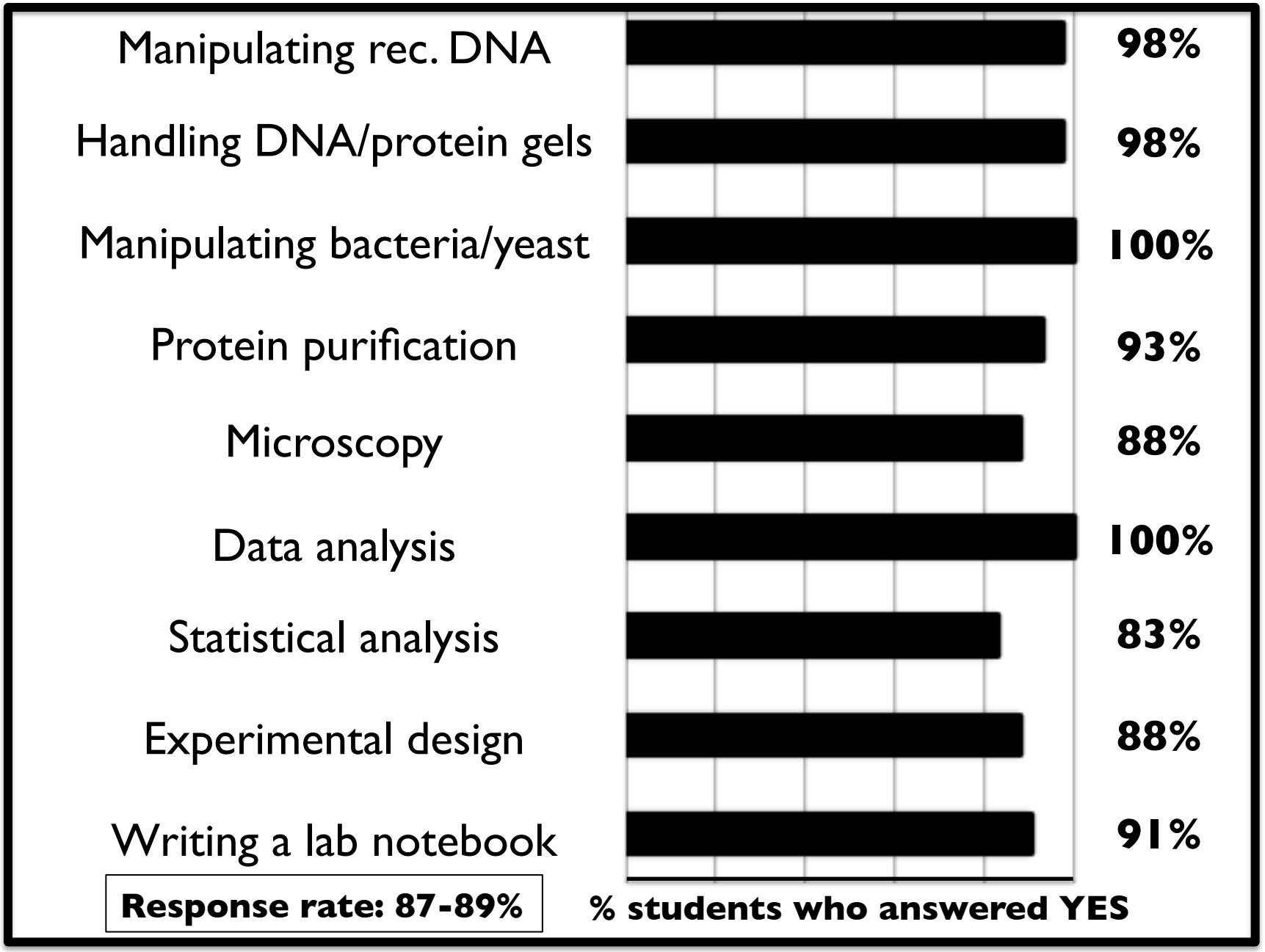
"Finding out the identity of our mutated gene"

"Seeing yeast under the microscope"

What was your favorite part of the Genetics Module?



Do you feel more comfortable with..



Learning goals in 7.02

- Experimental techniques
  - Practice
  - Theory
  - Troubleshooting
  - Writing a lab notebook
- Data analysis
- Scientific communication
- Experimental design

What was the most useful course component to help your understanding?

- TAs
- Practice problems
- Lectures
- Instructors
- Exams
- Review sessions
- In-lab questions
- SciComm
- Lab manual

Spring 2012-Spring 2014

What was the most useful course component to help your understanding?

- TAs
- Practice problems
- Lectures
- Instructors
- Exams
- Review sessions
- In-lab questions
- SciComm
- Lab manual

Spring 2012-Spring 2014

TAs: our most valuable resource!

- Four graduate and eight undergraduate TAs
- Graduate TAs undergo Biology Dept. TA training
- 7.02-specific training in TA Run-Through Week
- Weekly staff meetings

Can we have it all?

- Cookbook style versus open ended
- Breadth versus depth

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Graduate and undergraduate TAs

Thank you!

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Mandana Sassanfar
Beth Vogel-Taylor
Steve Bell
Monty Krieger
Krieger Lab Members
Alison Brauneis
Lourdes Aleman
Bob Horvitz
Wendy Gilbert
Lenny Guarante
Glenda Stump
Courtney Crummett
Wendy Salmon

UMass Worcester
Peter Pryciak
Duane Jenness

Stanford University
Mike Snyder
Tim Stearns

University of Michigan
Anuj Kumar

SUNY
Jamie Konopka
Deborah Spikes

Suffolk University
Melanie Berkmen

Princeton University
Allison Gammie

Brandeis University
Melissa Kosinski-Collins

Boston University
Meredith Knight

Funding


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The Alumni Class Funds
supporting education at MIT since 1994

Stay tuned for the next curriculum…