

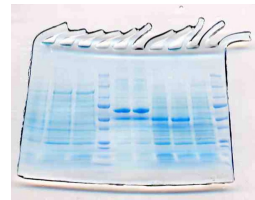
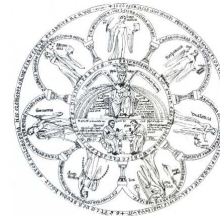
Welcome to 20.109

Laboratory Fundamentals of Biological Engineering

Orientation Lecture
Spring 2014

Introducing 20.109

- Philosophy
 - our goals and values
 - tips for success
- Mechanics
 - three experiments
 - assessments/communication
 - course logistics



20.109 faculty introductions

- Technical
 - Prof. Jon Runstadler (Mod 1)
 - Prof. Leona Samson (Mod 2)
 - Dr. Agi Stachowiak (Mod 3; W/F section)
 - Dr. Shannon Hughes-Alford (T/R section)
 - Aneesh Ramaswamy
- Communication
 - Dr. Marilee P. Ogren (written)
 - Dr. Leslie Ann Roldan (written)
 - Dr. Atissa Banuazizi (oral)
- Teaching assistants
 - Chris Bandoro, Su Vora, and Reggie Avery



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Course mission for 20.109

- To teach cutting edge research skill and technology through authentic investigation
- To inspire rigorous data analysis and its thoughtful communication
- To prepare students to be the future of Biological Engineering

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Making the most of 20.109

LESSONS FROM PRESCHOOL

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Choose a compelling problem

LJ, we have to put the human body together!



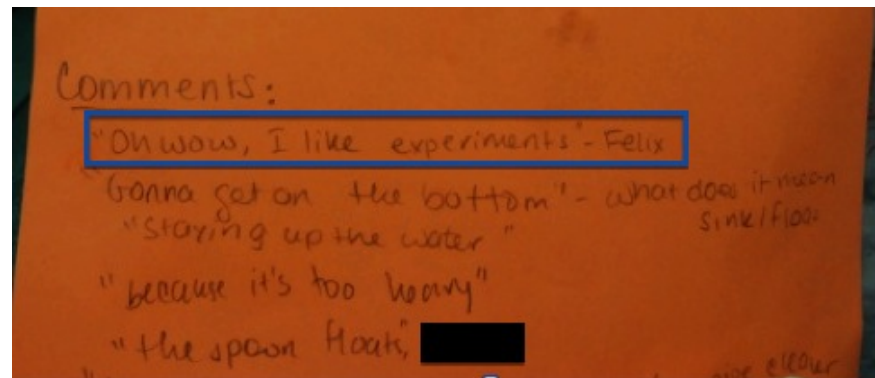
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It's okay when experiments "fail"

Object	Prediction	Outcome	
		Sink	Float
1. toy boat	float	✓	
2. rock	sink	✓	
3. pipe cleaner	float	✓	
4. foam piece	sink		✓
5. cube	sink		✓
6. marble	float	✓	
7. bead	sink		✓

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When you get an unexpected result



Cultivate joy

Ask why?

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Immersion facilitates rapid learning

Day	Answers to "What are your 5 senses?"
1	Senses is senses. Senses is dentist.
2	See, hear, mouth, fingers; Eyes to see. See, talk with my mouth, I put food in my mouth. Throw up with my mouth, hear with my ears, see Spider-man with my eyes.
3	Eyes, ears, nose, fingers, mouth; Eyes, fingers Eyes, ears, nose, mouth, hands Eyes, ears, mouth, legs, shoes Mouth, ears, shoes, feet, toes, socks Ears-listen, nose-smell, hands-clap and touch, eyes-see, mouth-talk and eat.

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But some things take A LOT of practice



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You'll only know what you're capable if you try



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We hope to teach you something memorable

After the video question...

What do you know about Space?

F-the sun is a star

X-Jupiter has a storm.

Discussion:

**What did you
learn/enjoy learning
about space?**

**I learn about astronauts float up in the air in
gravity. The moon is not a planet. -Y**

We don't have no gravity in space. -F

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Experiments and assessments

BACK TO 20.109

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Course mission for 20.109

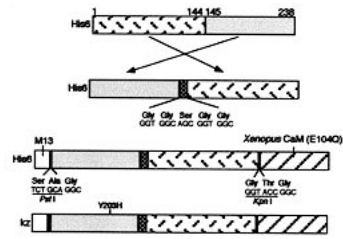
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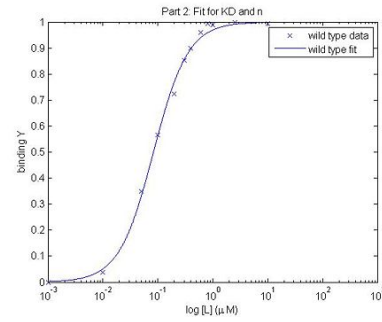
Engineering principles + modern biology

Manipulate and Make

Measure ← **Model**



Nagai *et al.*



Myriad length scales, systems, and applications

20.109(S14): Laboratory Fundamentals of Biological Engineering

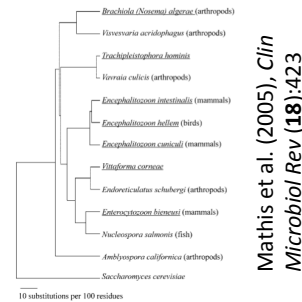
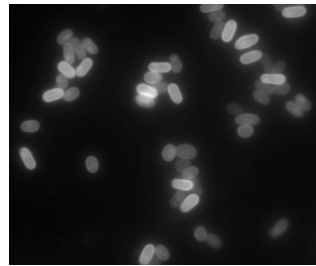


Home Schedule Spring 2014 Assignments
 Module 1 Module 2 Module 3

- Module 1 DNA Engineering (J. Runstadler)
- Module 2 System Engineering (L. Samson)
- Module 3 Cell Engineering (A. Stachowiak)

[openwetware.org/wiki/20.109\(S14\)](http://openwetware.org/wiki/20.109(S14))

DNA engineering: measuring microbes



Experimental Goals

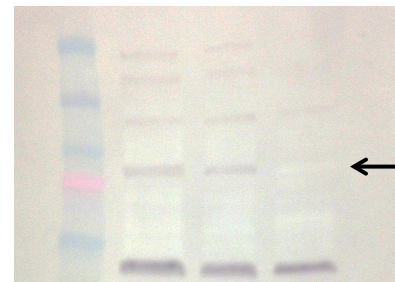
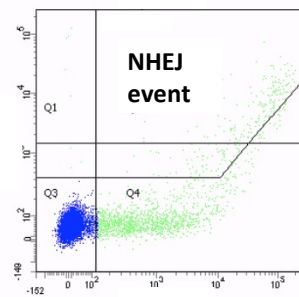
Discovery: Describe microbial communities
Design: Diagnostic primers

- Compare bacterial profiles in different bird populations
- Assess primer sensitivity/specificity

Lab+Analytical Skills

- Amplify and clone DNA
- Use computational tools: sequence and phylogenetic analyses
- Discuss/present scientific literature

System engineering: measuring DNA repair



Experimental Goals

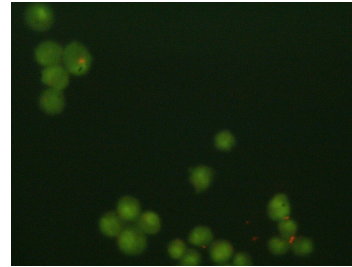
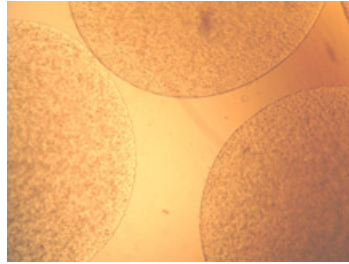
Choose: System conditions

- Determine how DNA topology and repair protein deletion or inhibition affect DNA repair

Lab+Analytical Skills

- Prepare and analyze damaged DNA
- Identify repair proteins (Western)
- Quantify DNA repair (flow cytometry)
- Make statistical comparisons

Cell engineering: making cartilage



Experimental Goals

Design: Culture conditions

- Study how cell environment affects its phenotype

Lab+Analytical Skills

- Culture mammalian cells
- Fluorescence microscopy
- Measure specific mRNAs (qPCR)
- Quantify protein (ELISA)
- Present a novel research idea

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Evaluating your understanding

Module	Assignment	Worth (%)
1	Abstract and data summary	15
1	Primer design memo	5
1	Journal club <u>oral</u> presentation	10
2	Research article	25
3	Research idea <u>oral</u> presentation	20
3	Mini report	5

Remaining 20% comes from daily work and participation.

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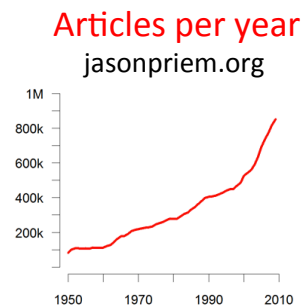
Scientific communication resources

- Marilee P. Ogren and Leslie Ann Roldan (WAC)
 - lectures/discussions in class
 - written feedback on draft report sections
 - office hours by appointment
- Atissa Banuazizi (WAC)
 - lectures/discussions in class
 - one-on-one review of videotaped talk
- BE Writing Lab
 - Writing Fellows provide peer coaching

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Scientific writing must tell a story

- Stories engage us and help us remember
- You **discover** the story of the data
- Then convince an **audience** using
 - logical structure
 - clear explanations
 - effective visuals
 - repetition of key ideas



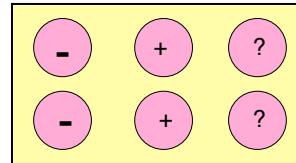
Your data should be true even if your story is wrong

~ **Darcy Kelley, Columbia** (from *The Canon*, N. Angier)

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After 20.109, you should be able to...

- Organize a constructive lab notebook
- Implement laboratory protocols and start to troubleshoot
- Design novel experiments with appropriate controls
- Interpret qualitative data
- Analyze quantitative data
- Recognize utility of models
- Critically examine the scientific literature
- Communicate in multiple modes
- Collaborate effectively with fellow scientists/engineers



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Logistics and finalizing registration

- Lecture (16-220)
 - Tue/Thu, 11am – 12pm
 - big picture goals, concepts, theories, applications
- Lab (56-322)
 - T/R 1-5pm or W/F 1-5 pm
 - practical advice, background about methods
 - no(*) make-up labs
- A few key notes
 - you will work in pairs
 - we encourage and expect [collaboration with integrity](#)

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