Strategies for teaching in classrooms with ever increasing diversity

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HHMI Professor and Investigator

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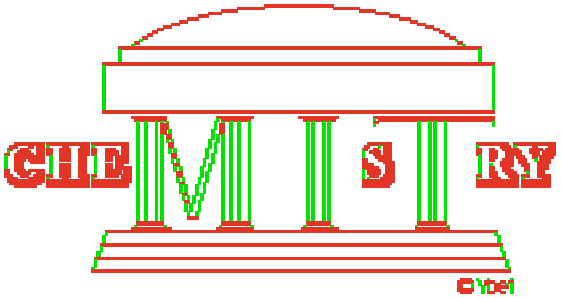
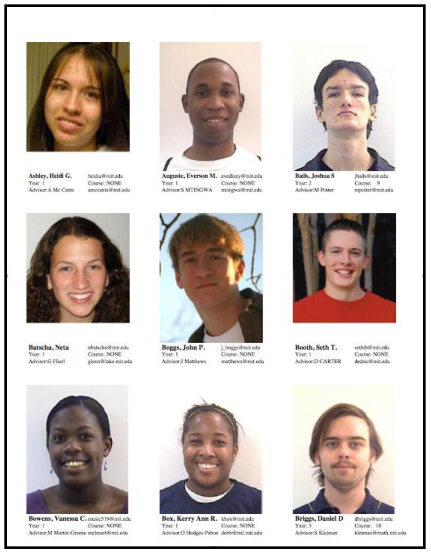
My Motivation





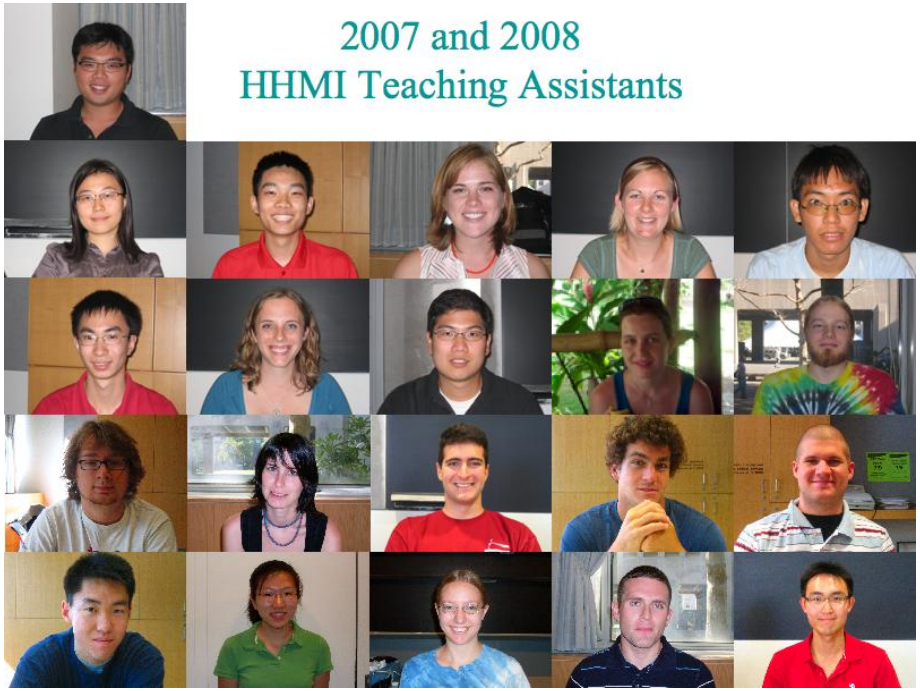
“I never had a chemistry TA that believed in me.”

“I never saw anyone in chemistry who looked like me.”

My Goals

- Create TA-training material on diversity issues
- Implement lessons from training in the classroom
- Create teaching material to show what chemists really look like

Who are the TAs that we are training?



First year graduate students in chemistry at MIT

40-60 total per year, ~10 for Fall 5.111and ~5 for Spring 5.111

Of total: 45% female; 0.09% URM; 37% International

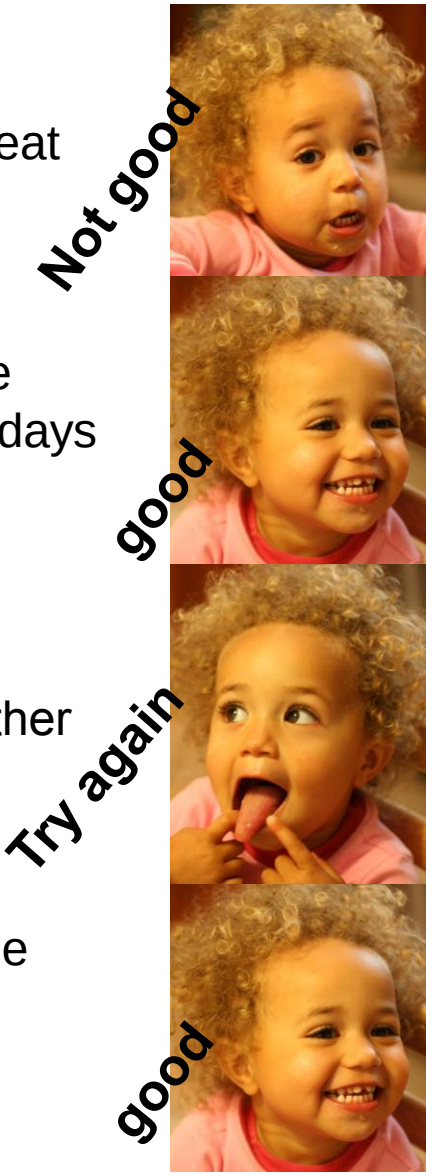
What we tried

Fall 2007: Invited speaker on topic of diversity for all Chemistry Department TAs; 5.111 TAs also read article on Stereotype Threat (no discussion of article)

Fall 2008: Only 5.111 TAs received diversity training; read same article as year before, but discussed article in small group, four days into the training when everyone knew each other

Fall 2009: All Chemistry TAs read same article and discussed article in small groups, but people in groups didn't know each other

Spring & Fall 2010-20111: All Chemistry TAs read a custom prepared article and discussed article in small groups, after three days into training when everyone knew each other



Articles that we used

Cohen, C. L. and Steele, C. M. (2002). A Barrier of Mistrust: How Negative Stereotypes Affect Cross-Race Mentoring. Elsevier Science, 303-327

Glenn, W.S., Taylor, E.M.V., Drennan, C.L. (Draft 2011) But I Don't Like Beer *A Guide to Identifying and Reducing Stereotype Threat to Maximize Student Performance*

81% found the second diversity reading assignment effective
67% found it enjoyable

Major goals of the training

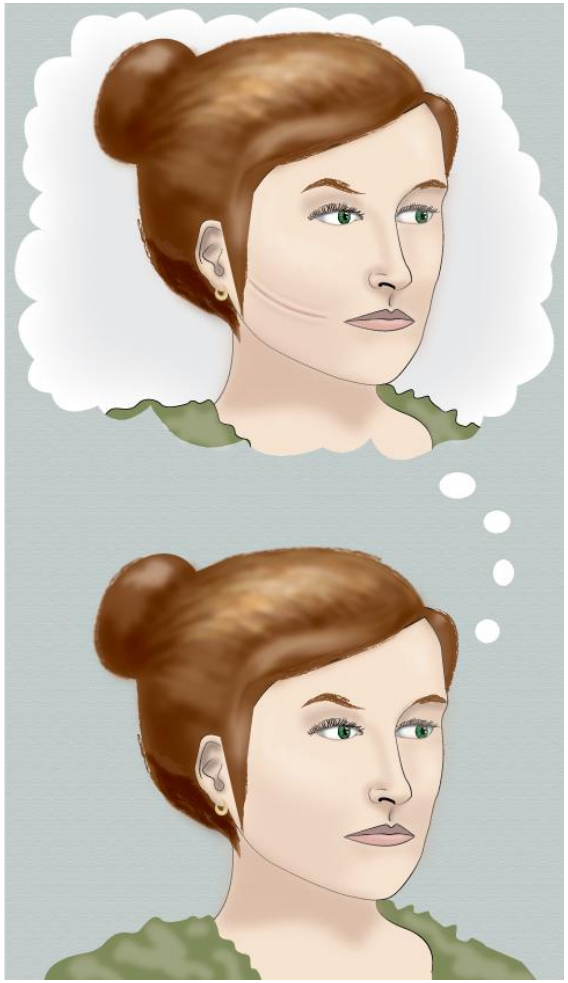
Understand what stereotype threat is
Stereotype threat is the perceived risk of confirming a negative stereotype.

Understand that stereotype threat can cause underperformance

Understand that everyone can be a victim as stereotype threat

Understand that there are ways to mitigate the effects of stereotype threat
Example: Give wise criticism – Criticism where you explicitly let the student know they are capable of a higher level of achievement.

Stereotype threat leads to feelings of being judged unfairly



Asked volunteers to test whether they were treated differently by others if they had a scar on their face

Volunteers spent time in make-up and saw how they looked with the scar

<u>but</u> before they went into the meeting, the scar was wiped off without their knowledge

Volunteers reported discrimination

Kleck & Strenta 1980

Exercise

Turn to your neighbor, can you recall a time that you felt judged by some for a superficial characteristic

or when you worried about confirming a negative stereotype


UNDESERVED PRAISE
This is a good score for you! You should be pleased.
Yeah, you'll need to try harder than that if you want to pass my class.
BAD CRITICISM
She thinks I'm an idiot. I knew I didn't belong here.
NO FEEDBACK
You nailed the titration questions, so I know you can do well on tough material. You're having a tougher time with thermochemistry. Let's talk about what you can do to improve.
WISE CRITICISM

Exercise

Turn to your neighbor, think of the last criticism you gave a student or a criticism that you are planning to give. Phrase it in an unwise way and then think of a “wise” way to say it.

Assessment of training

Teaching and Learning Laboratory at MIT

- TA surveys
- Individual TA interviews (post-bootcamp and post-course)
- Student survey on the TA and recitation experience

Rudolph Mitchell

Associate Director

T|L|L

Teaching & Learning Laboratory

Evaluation of TA training (2010 data)

TAs' confidence in understanding diversity issues increased*

	Pre		Post			
	Mean	**SD**	**Mean**	**SD**	**N**	***p***
Understanding diversity issues in the classroom.	4.23	1.15	5.94	0.86	48	0.000
I am familiar with strategies to alleviate diversity issues in the classroom.	3.53	1.41	5.53	1.06	47	0.000

*Students use a seven-rating scale to rate each item.

Evaluation of TA training (2010 data)

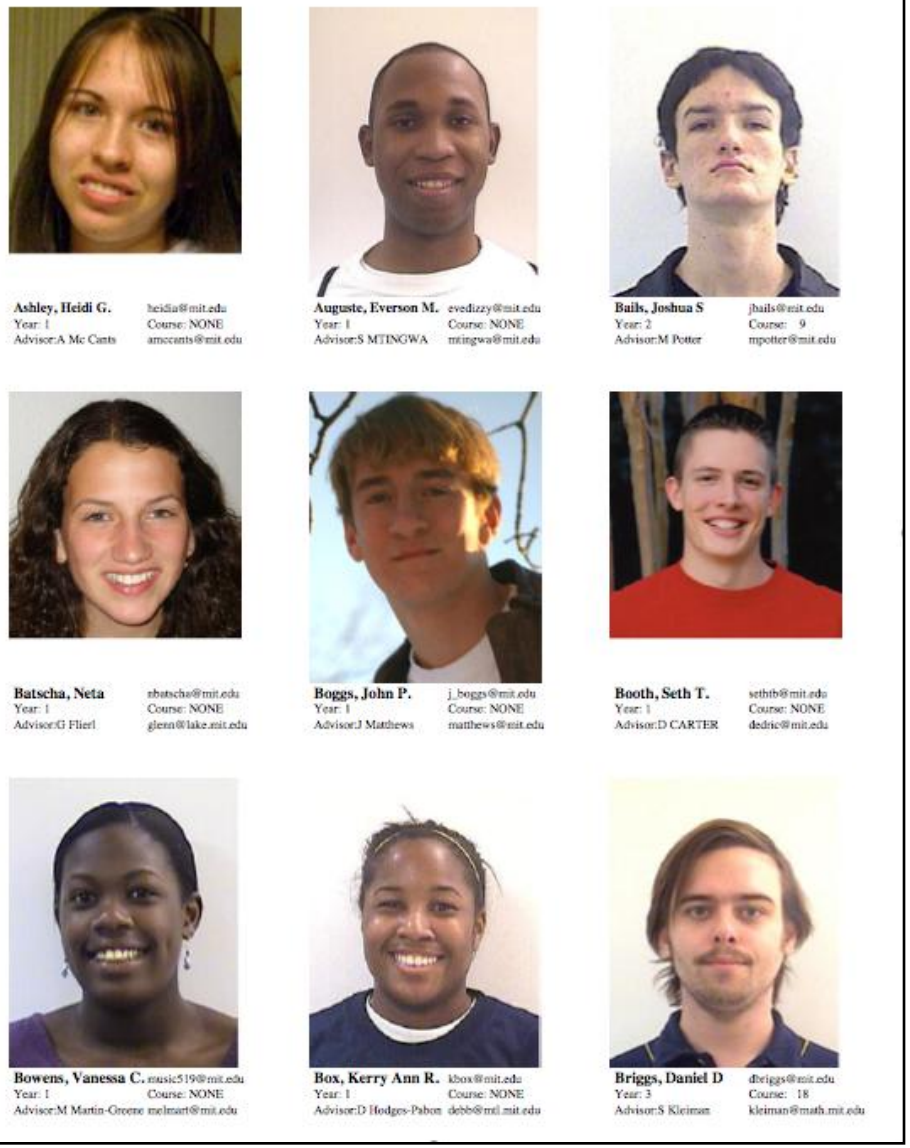
TA attitudes changed

	Pre		Post			Paired Samples Statistics
	Mean	**SD**	**Mean**	**SD**	**N**	
I believe to be an effective teacher, a TA must understand how diversity issues and stereotypes can affect the learning experience.	4.60	1.23	5.85	1.10	47	0.000
In addition to my teaching, I can apply diversity training to other aspects of my life.	4.94	0.99	5.91	1.06	47	0.000

My Goals

- Create TA-training material on diversity issues
- Implement lessons from training in the classroom
- Create teaching material to show what chemists really look like

Who are the students of these TAs?



Student makeup of one version of MIT freshman chemistry (5.111)

In fall course, 210-300 students

Female: ~66%

URM students: ~25%

In spring course, 120-220 students

Female: ~57%

URM students: ~20%

Implementation of training

Idea

Build team using clickers
and in-class competitions

Consider a drug, HA, that is active only in the deprotonated (A^-) form.
The pKa of the drug is 4.0,and the pH of blood is 7.4.

Select the correct statement below.

1. Most of the drug will be in the active (A^-) form in the bloodstream.
2. Most of the drug will be in the inactive (HA) form in the bloodstream.
3. The ratio of A^- to HA will be approximately 1:1 in the bloodstream.

Consider a drug, HA, that is active only in the deprotonated (A^-) form.
The pKa of the drug is 4.0,and the pH of blood is 7.4.

Select the correct statement below.

72% **1. Most of the drug will be in the active (A^-) form in the bloodstream.**

26% **2. Most of the drug will be in the inactive (HA) form in the bloodstream.**

2% **3. The ratio of A^- to HA will be approximately 1:1 in the bloodstream**

Implementation of training

Freshmen response to their TAs

	2007			2008			URM		
	mean	SD	N	mean	SD	N	mean	SD	N
My TA wanted us to do well.	6.6	.80	190	6.5	.74	168	6.6	.59	41
My TA was enthusiastic about chemistry.	6.5	.79	191	6.2	1.1	168	6.3	.88	41
My TA was well prepared.	6.2	1.1	191	6.2	1.1	168	6.4	.94	41
Recitation complimented lecture concepts and attitude.	5.9	1.3	191	6.0	1.3	166	6.0	1.2	39

7 point rating scale: 1 = strongly disagree, 4 = neutral, 7 = strongly agree

Freshmen response to clicker competitions

Student responses with (2008) and without (2007) clicker competitions

	2007	2008
I made an effort to answer clicker questions as well as I could.	6.2	6.2
Clicker questions stimulated me to **think conceptually** during the lecture.	5.1	5.7
Clicker questions helped me **identify weaknesses** in my understanding	5.1	5.6
I enjoyed using the clickers.	4.5	5.3
I enjoyed the clicker competitions	-	5.6

7 point rating scale: 1 = strongly disagree, 4 = neutral, 7 = strongly agree

Freshmen response to clicker competitions

Student responses with (2008) and without (2007) clicker competitions

	2007	2008	2008 URM
I made an effort to answer clicker questions as well as I could.	6.2	6.2	6.1
Clicker questions stimulated me to **think conceptually** during the lecture.	5.1	5.7	5.8
Clicker questions helped me **identify weaknesses** in my understanding	5.1	5.6	5.6
I enjoyed using the clickers.	4.5	5.3	5.3
I enjoyed the clicker competitions	-	5.6	5.4

7 point rating scale: 1 = strongly disagree, 4 = neutral, 7 = strongly agree

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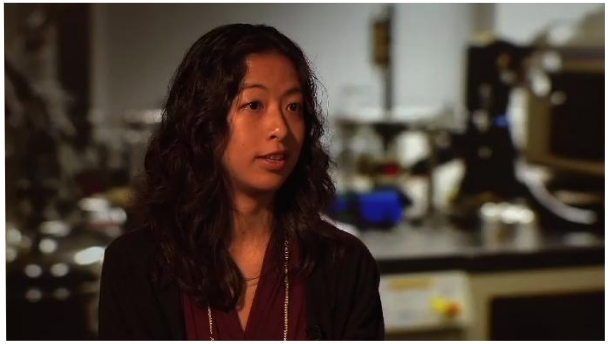
The “Who” of Chemistry












Research Videos showing the Faces of Chemistry at MIT

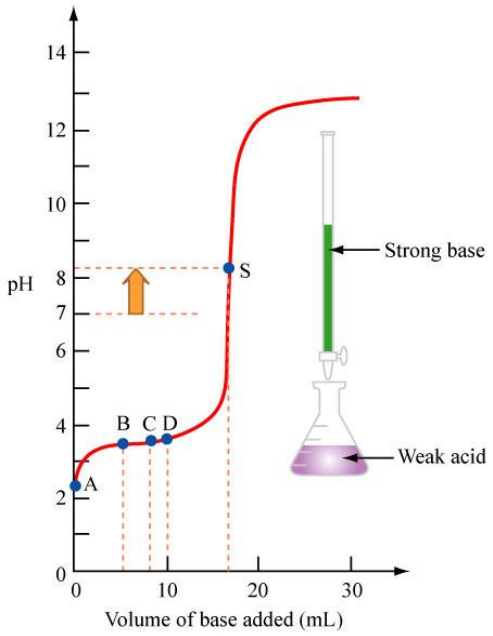
The *Why, What* and *Who* of Chemistry

A series of 12 science videos and 12 personal videos that include

- **twelve distinct general chemistry principles**
- **real-world applications in medicine, energy and environment**
- **a diverse group of researchers**

Do people actually use the stuff they learn in freshman chemistry?	How can chemical principles be used to solve real-world problems?	What do real chemists look like?

Research Videos showing the Faces of Chemistry at MIT

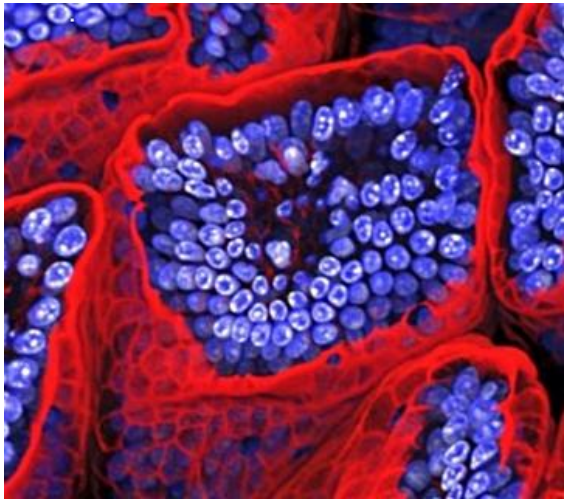


General chemistry topic:
pH and pKa

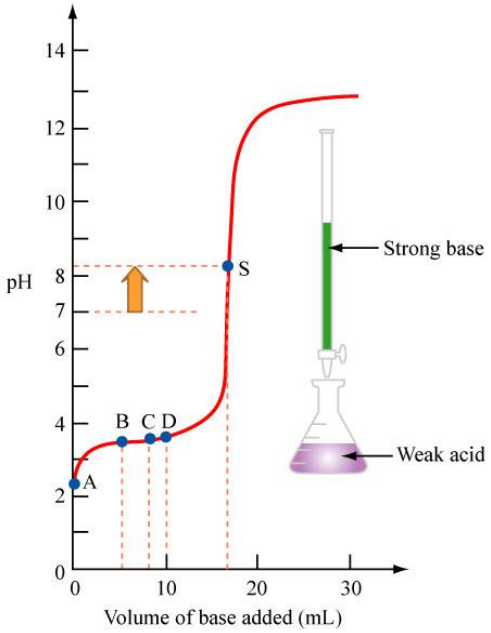
Do people actually use the stuff they learn in freshman chemistry?

What do real chemists look like (apart from the dead white men in textbooks)?

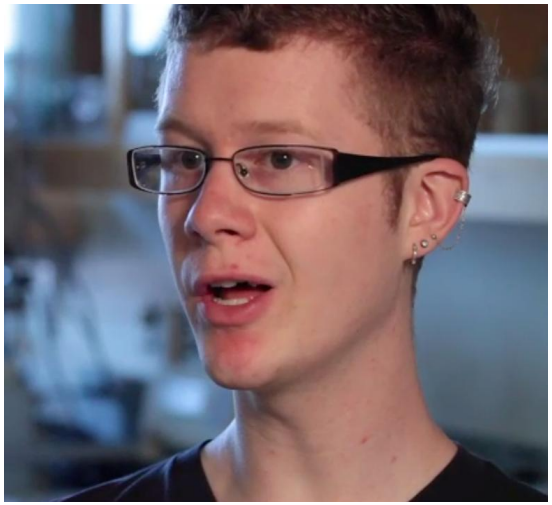
Research Videos showing the Faces of Chemistry at MIT



Application: imaging diseased cells

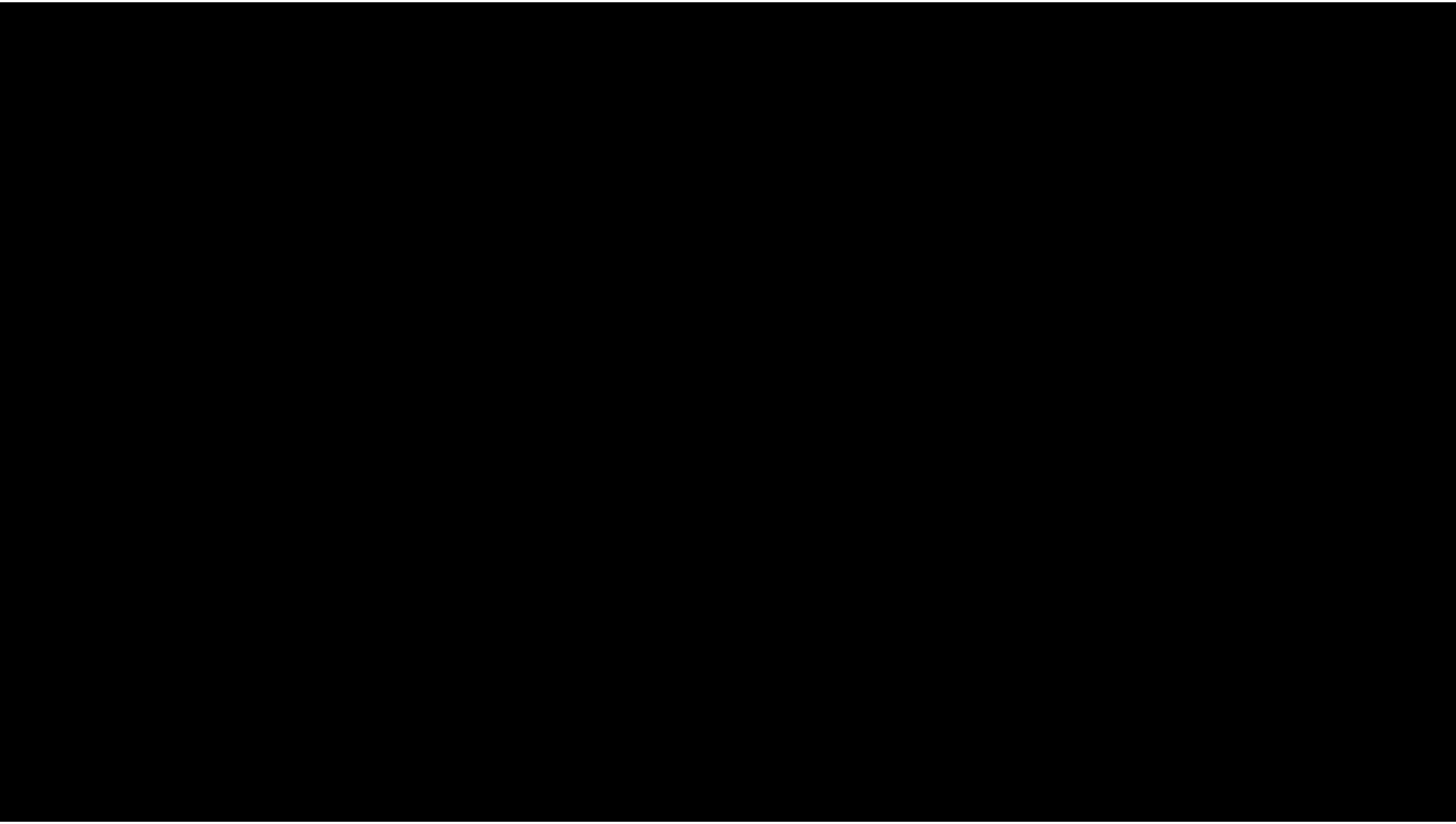


General chemistry topic: pH and pKa

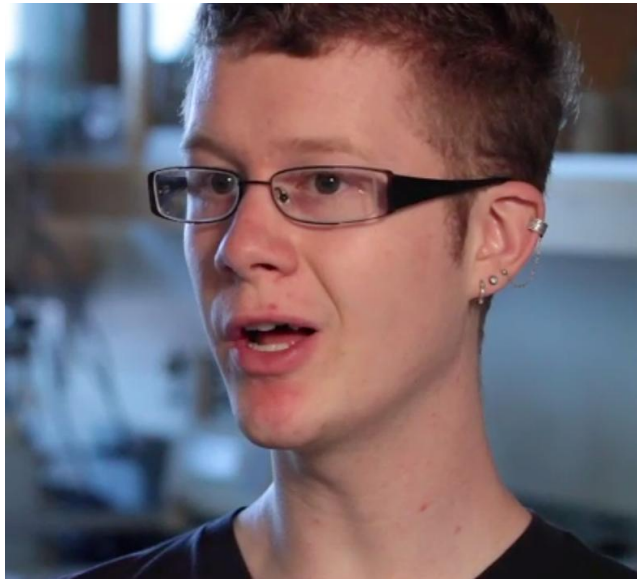


MIT Researcher: undergrad Samuel Thompson

Samuel Thompson: MIT undergraduate in the Ting lab

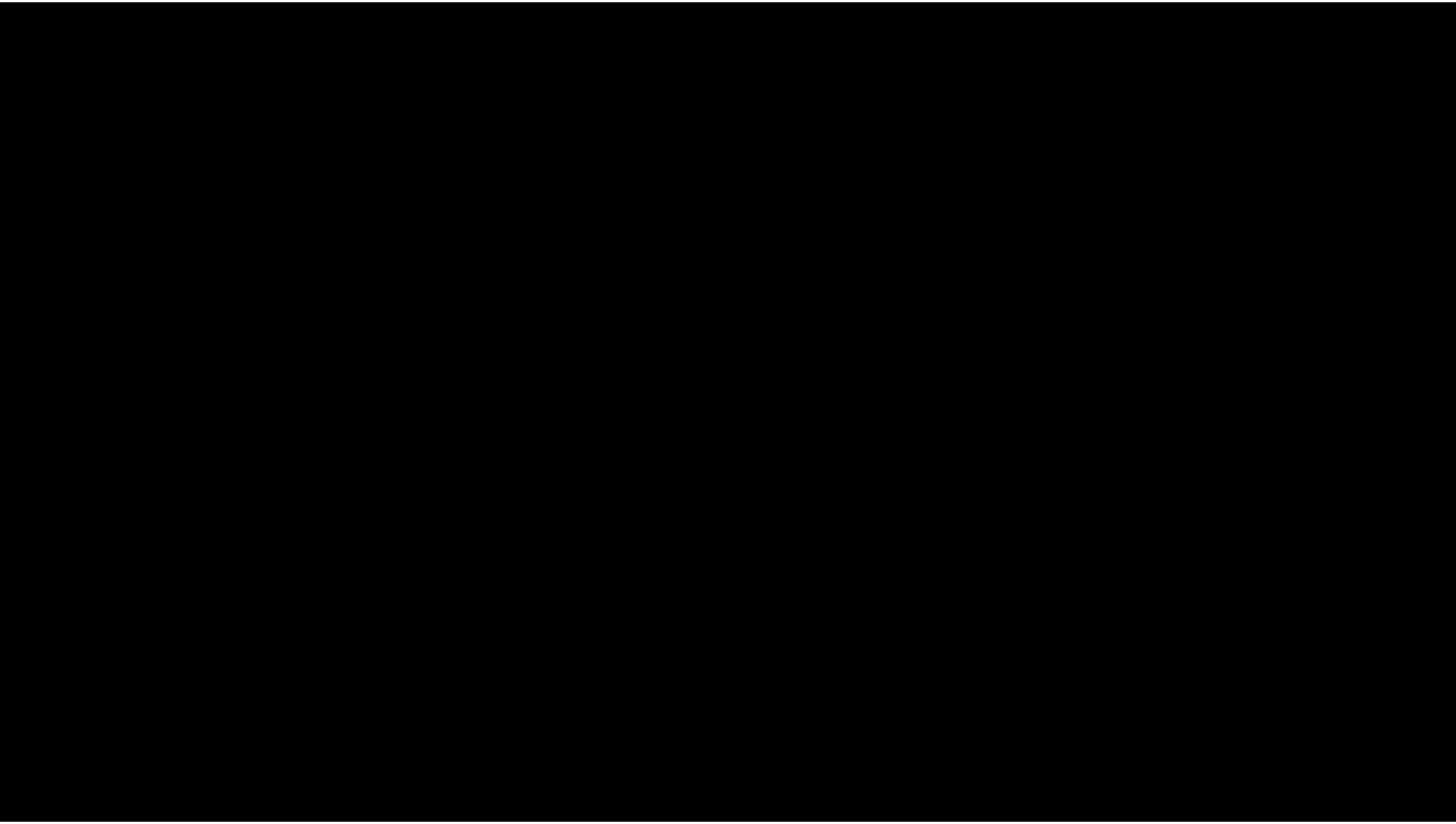


Personal Videos showing the Faces of Chemistry at MIT



Equality Texas: Samuel's Story

Personal Videos showing the Faces of Chemistry at MIT



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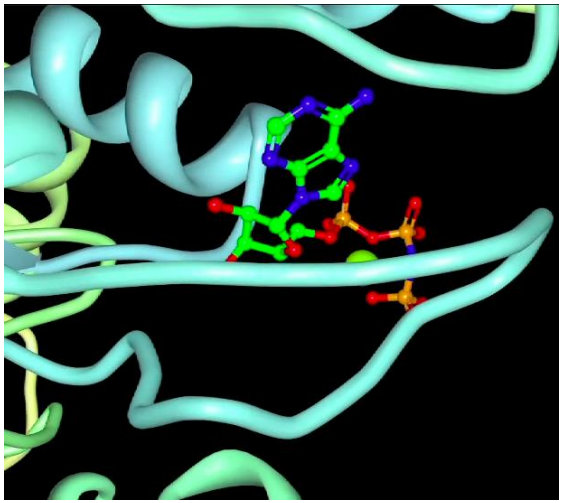
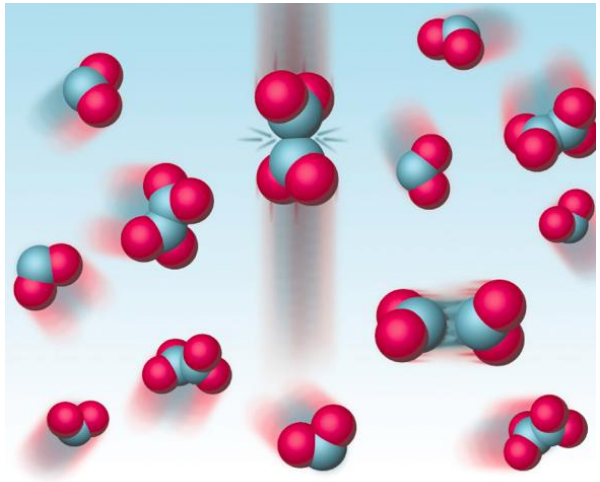
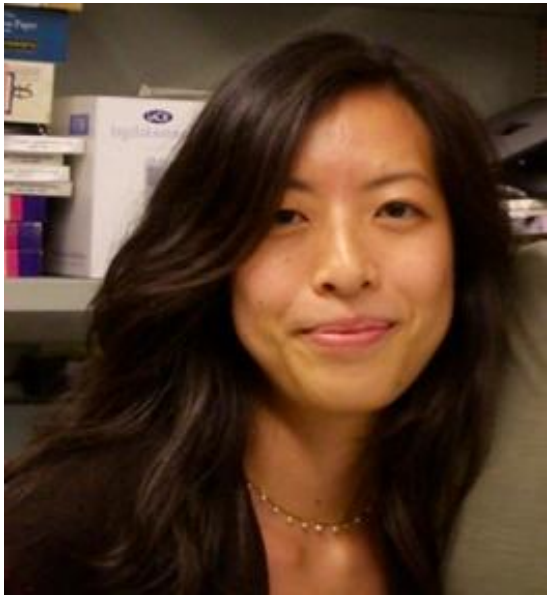


Application:
Studying an anti-cancer and anti-bacterial enzyme target



General chemistry topic:
Chemical Equilibrium



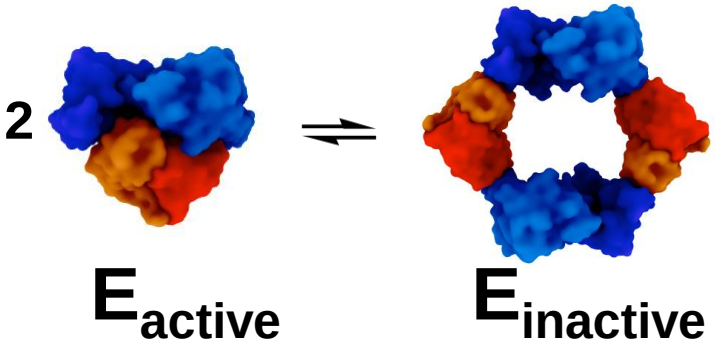
MIT Researcher:
Postdoctoral fellow
Dr. Nozomi Ando

Nozomi Ando: MIT postdoc in the Drennan laboratory

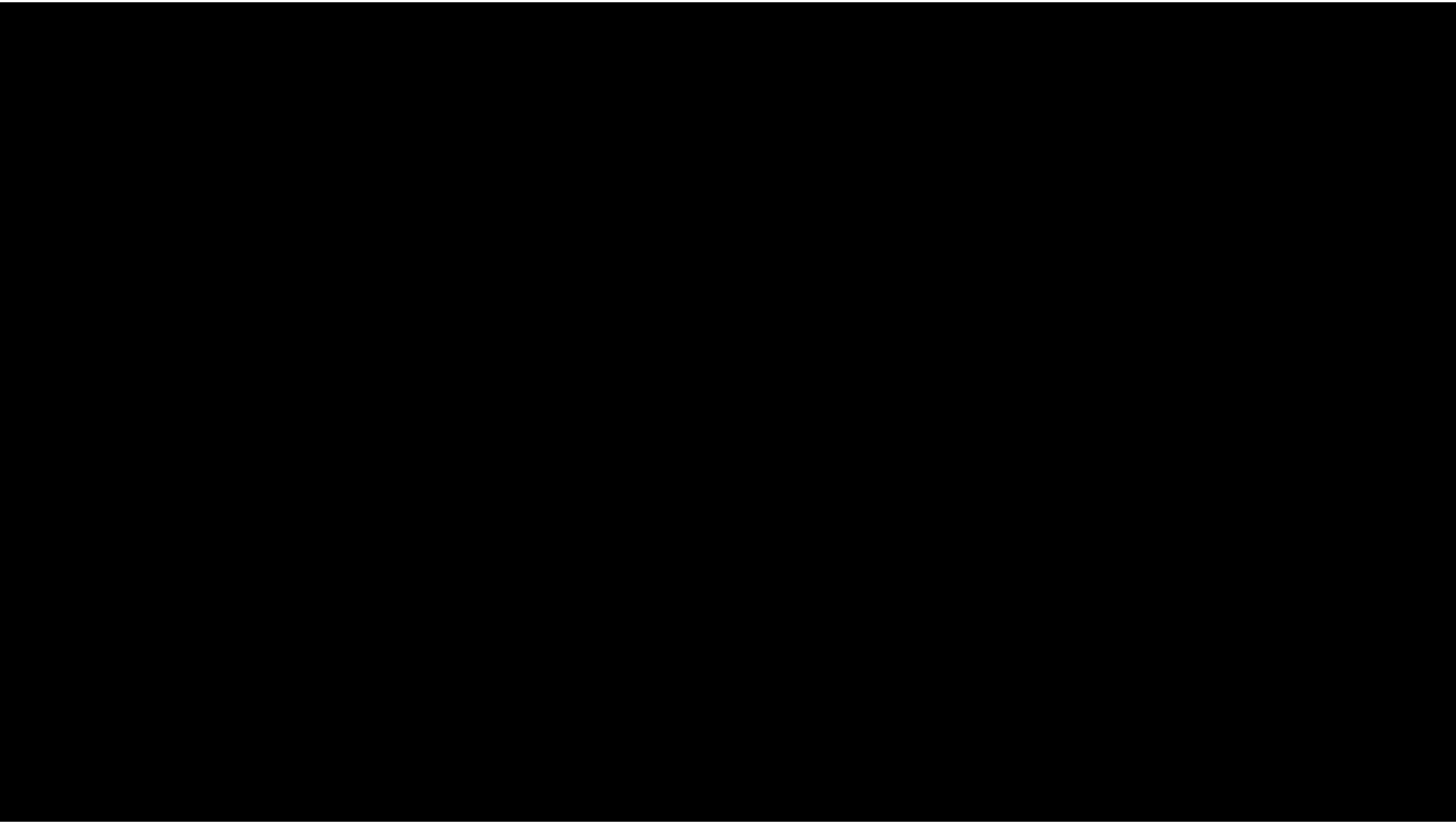
Chemical equilibrium is relevant to more than just gas molecules!

Gas molecule example: $2P_2\,(g) \rightleftharpoons P_4\,(g)$

Biochemical example:



Nozomi Ando: MIT postdoc in the Drennan laboratory



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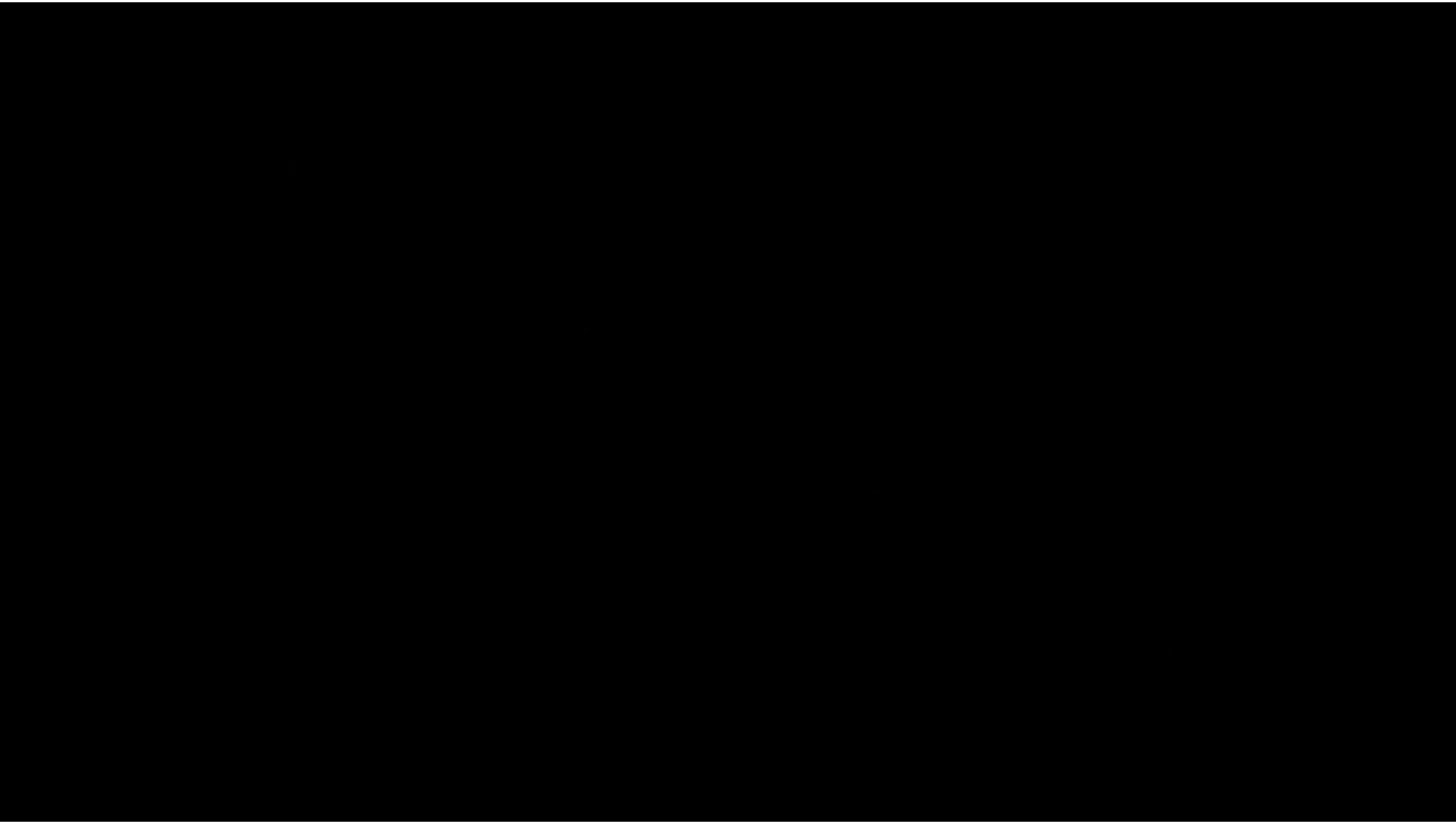
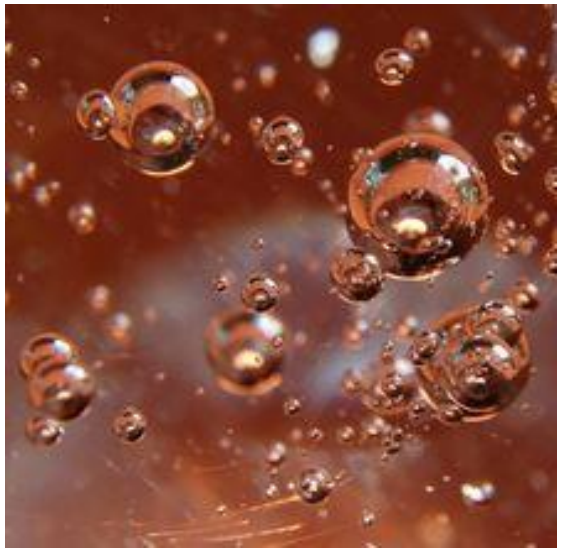


Research Videos showing the Faces of Chemistry at MIT

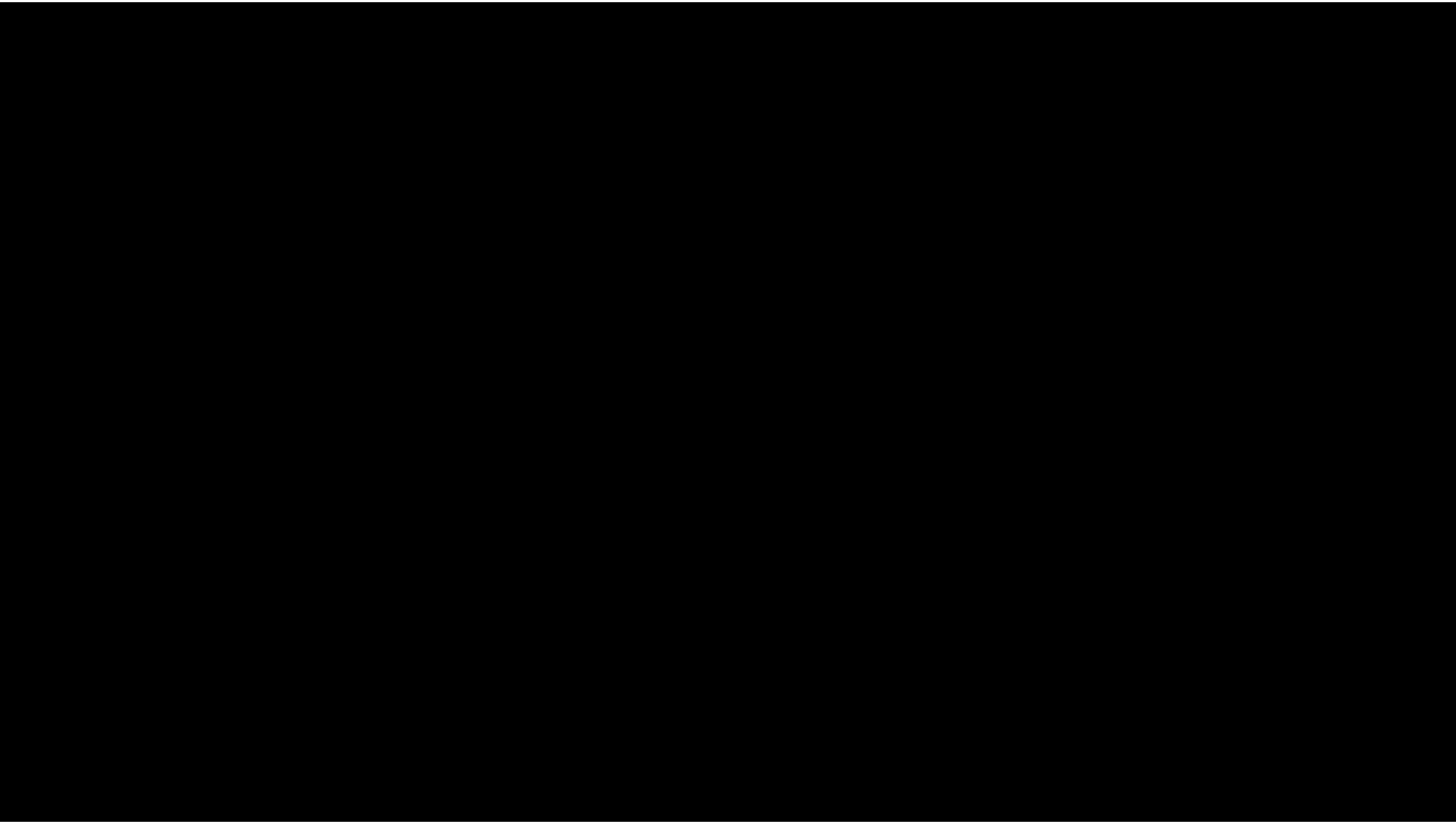
CO_2 sequestration and use



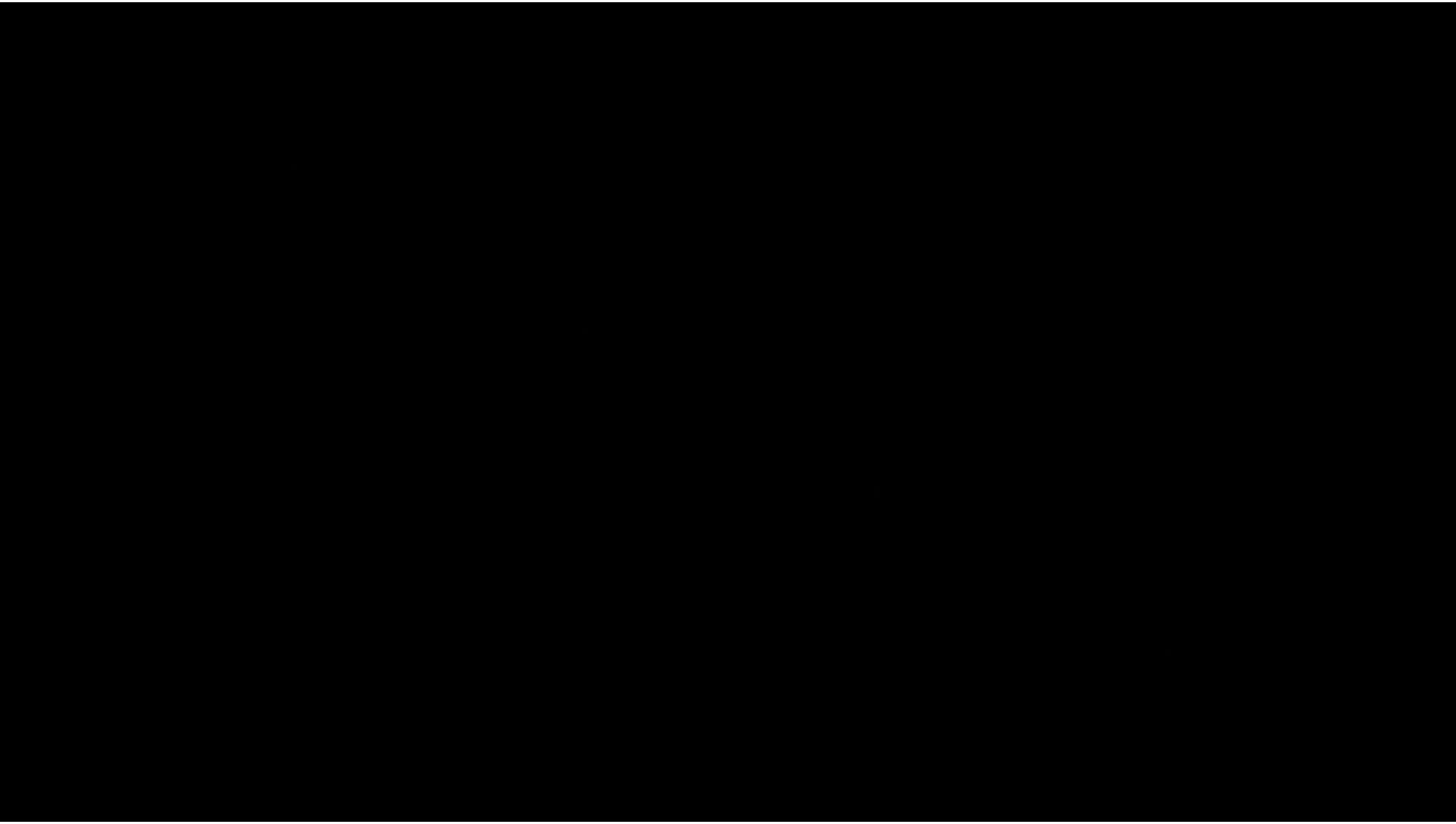
General chemistry topics:
Solubility
Le Chatelier's Principle

MIT Researcher:
Hector Hernandez

Hector Hernandez: MIT postdoc in the Thompson laboratory



Hector Hernandez: MIT postdoc in the Thompson laboratory



Assessing impact: Faces of Chemistry videos

From Spring 2011 Retrospective Survey (no videos yet!)

As a result of this class,	mean	% agree
I have been exposed to examples of chemists from different ethnic groups.	4.2	43%

1.....4.....7

poor/ strongly disagree **neutral** **excellent/ strongly agree**

Assessing impact: Faces of Chemistry videos

From Spring 2011 Retrospective Survey (no videos yet!)

As a result of this class,	mean	% agree
I have been exposed to examples of chemists from different ethnic groups.	4.2	43%
I have been exposed to examples of women who are chemists (in addition to my professors and TAs)	5.4	81%
I encountered examples of chemists with whom I could identify because of their gender/ethnicity/background.	4.4	42%

1.....4.....7

poor/ strongly disagree — **neutral** — **excellent/ strongly agree**

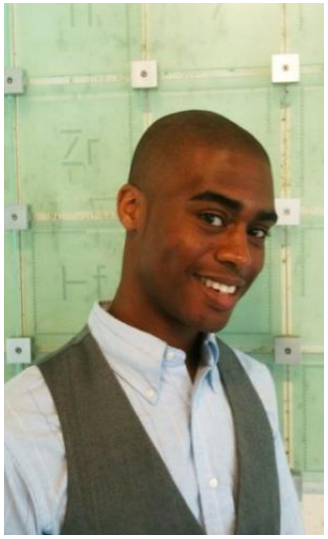
Acknowledgements

HHMI
HOWARD HUGHES
MEDICAL INSTITUTE

Massachusetts
Institute of
Technology

class of 2009

Beth Taylor



Wes Glenn

Rudy Mitchell

George Zaidan

Mary O'Reilly

THE *WHY* AND THE *WHO* OF CHEMISTRY

A series of research videos highlighting the many faces of chemistry at MIT sorted by:
(brief description of resource here…)

Do people actually use the stuff they learn in freshman chemistry?

Research videos organized by chemistry topic

How can chemical principles be used to solve real-world problems?

Research videos organized by real world research topic

What do real chemists look like (apart from the dead white men in textbooks)?

Personal videos: real stories from real chemists

**** Starring MIT chemists ****

**** Produced by chemists *** **Prof. Cathy Drennan, Dr. Beth Taylor, George Zaidan**

**** Directed by a chemist *** **George Zaidan**

**** Art by a chemist (yes, chemists can be artists too)*** **Dr. Mary O'Reilly**

How do we increase the impact on URM students / women?

Inspiration from discussions and evaluation comments:

This is one of the very few science/engineering classes that are taught by female professors. I've been here at MIT for 4 years, and this class is the 2nd class I've had with female professors. I think it's super important to give a sense that women can do science and engineering too.

THE *WHY* AND THE *WHO* OF CHEMISTRY

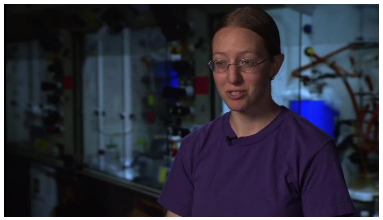
What do real chemists look like (apart from the dead white men in textbooks)?

Personal videos: real stories from real chemists

Download all 12 personal videos

Benjamin Ofari-Okai
Graduate student

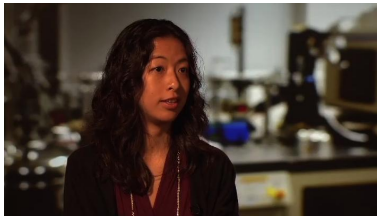
Dr. Lourdes Aleman
Postdoctoral associate



Darcy Wanger
Graduate student

Dr. Sarah Bowman
Postdoctoral associate

Dr. Hector Hernandez
Postdoctoral associate



Dr. Nozomi Ando
Postdoctoral associate

Prof. John Essigmann
Professor

Wesley Glenn
Graduate student

Jingnan Lu
Graduate student

Prof. Cathy Drennan
Professor

Samuel Thompson
Undergraduate student

Stefanie Sydlik
Graduate student