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Stand up.

**Please sit at a table next to
someone you don't know.**

6+ people per table.



Emotional Engineering: The Olin Approach

Mark Somerville, Professor & Special Advisor to the Provost, Olin College

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**Introduce yourself to the
person next to you, and share
one thing they probably
wouldn't guess about you...**



The Olin Story

What Matters?

THE OLIN STORY

1990s: Calls for change; The F.W. Olin Foundation responds

\$500,000,000 to start a
new college.

Desired outcomes:

*Prepare engineering
innovators; **and***

*Drive change in
engineering education.*



**Pair discussion: You're
starting a college from
scratch...**

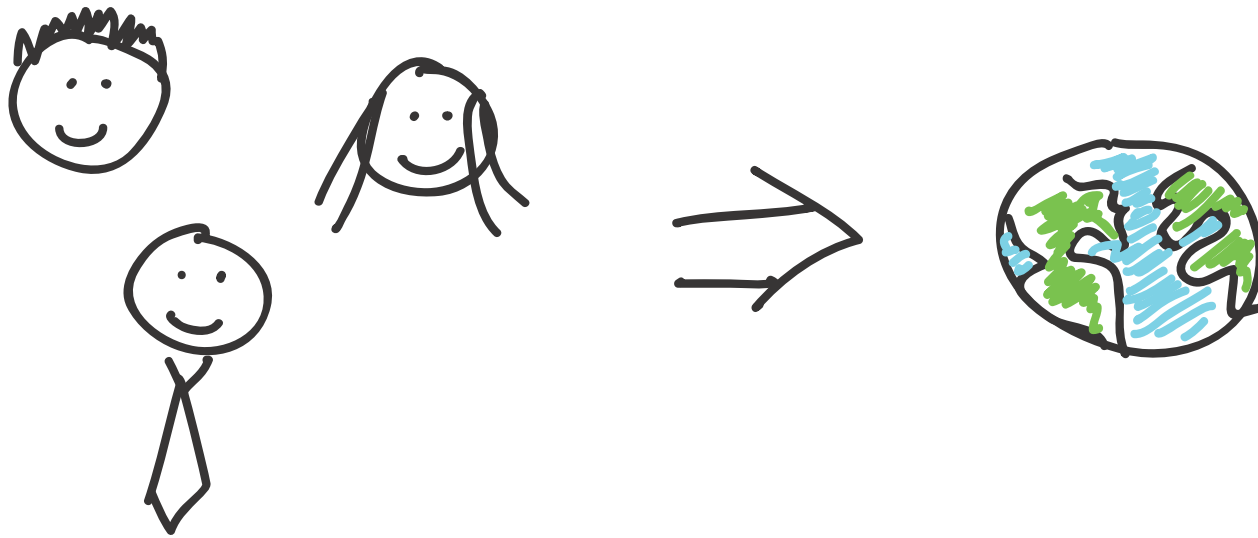
You have \$500,000,000.

What's on your to-do list?

1999



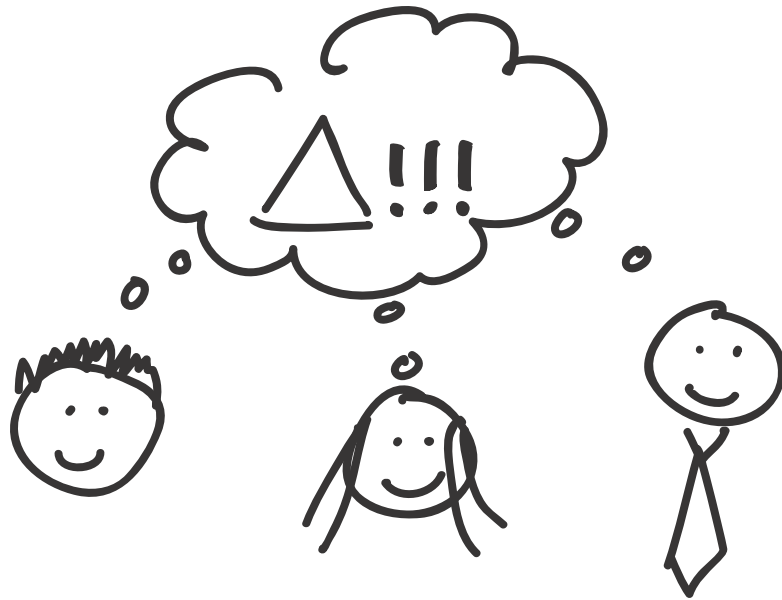
2000



Leadership and 8 faculty recruited from top schools (MIT, Berkeley, Vanderbilt, etc.).

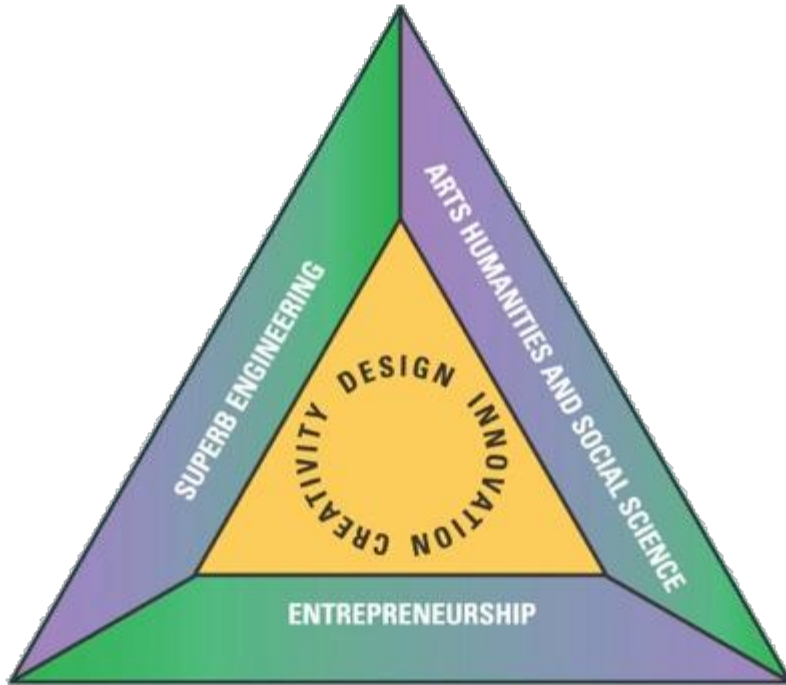
Benchmark visits to >50 schools, companies, etc.

2000



The team agrees on a vision.

2000



Hands-on design, every
year

Authentic capstone

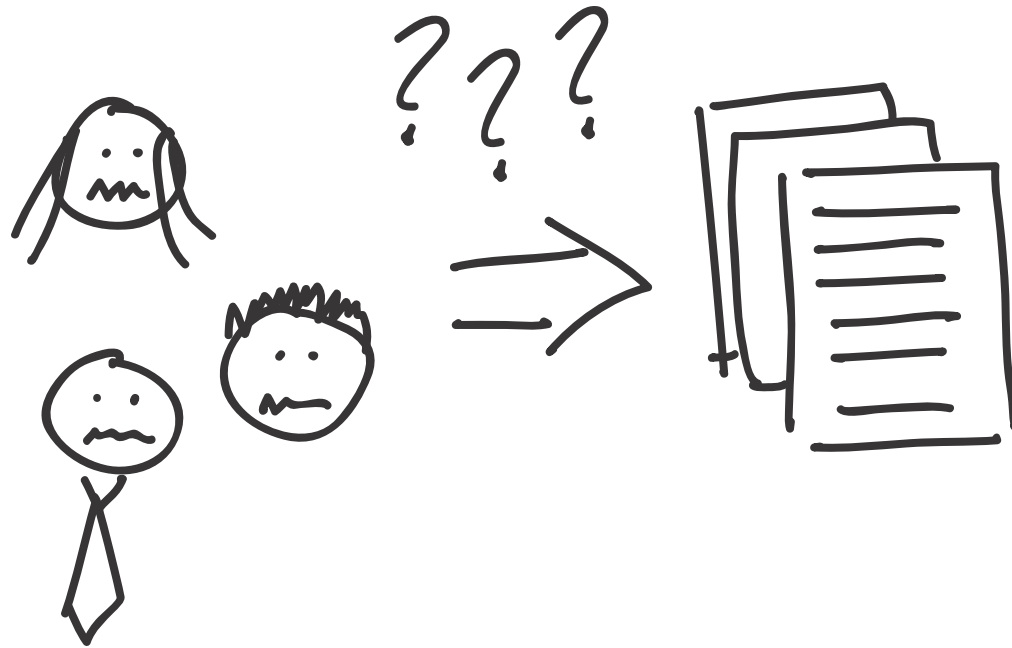
Work independently, as
team member, and as
team leader

International experience

Communicate effectively

Articulate a vision and
bring it to fruition

Student flexibility



Invention was more challenging.

2001



2001

1. Understand complexity and asymptotic algorithms
 2. Implement recursive algorithms in the form of a computer code
 3. Develop problem-solving skills

1.1.1

Problem	Complexity	Example	Optimal solution
Linear search	$O(n)$	Find the index of an element in an array	Linear search
Binary search	$O(\log n)$	Find the index of an element in a sorted array	Binary search
Insertion sort	$O(n^2)$	Sort an array of numbers	Insertion sort
Selection sort	$O(n^2)$	Sort an array of numbers	Selection sort
Bubble sort	$O(n^2)$	Sort an array of numbers	Bubble sort
Quick sort	$O(n \log n)$	Sort an array of numbers	Quick sort
Merge sort	$O(n \log n)$	Sort an array of numbers	Merge sort

KEY QUESTIONS:

What is the worst case of algorithm? How to improve the performance of an algorithm? How to analyze the complexity of an algorithm?

Calc

Linear Alg

Linear search: $O(n)$

Binary search: $O(\log n)$

Insertion sort: $O(n^2)$

Selection sort: $O(n^2)$

Bubble sort: $O(n^2)$

Quick sort: $O(n \log n)$

Merge sort: $O(n \log n)$

4800

Reflection, refraction, diffraction, interference

Learning objectives

(a) ... (b) ... (c) ...

Electronics RE

CONCEPT EXPLANATION

DEVELOP LIGHT!

ESTIMATE GIVE END

A-TIC COLLECT PMS

DEVELOP PMS

2.2.1

Linear search

Binary search

Insertion sort

Selection sort

Bubble sort

Quick sort

Merge sort

3.1.1

Linear search

Binary search

Insertion sort

Selection sort

Bubble sort

Quick sort

Merge sort

CHOOSE HUMAN

FIRST PRINCIPLE

ASSUMPTION

RELATIONSHIP

3.1.2

Linear search

Binary search

Insertion sort

Selection sort

Bubble sort

Quick sort

Merge sort

ASSUMPTION

(a) ... (b) ... (c) ...

EXAMPLES

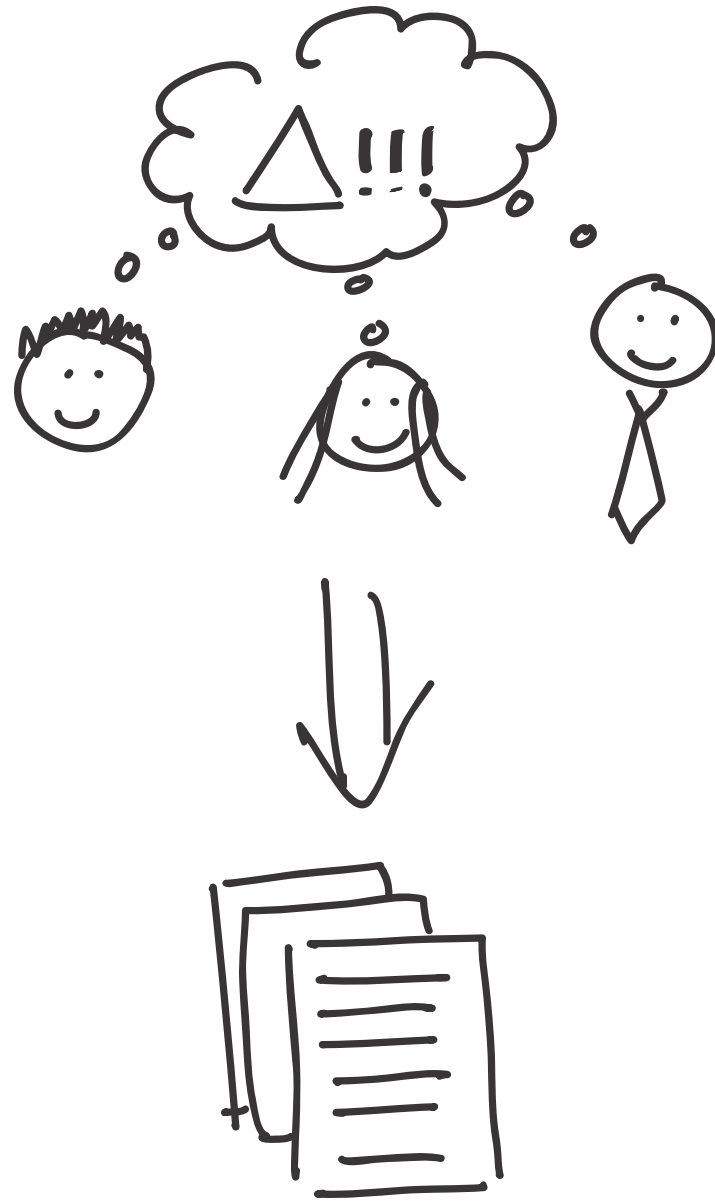
(a) ... (b) ... (c) ...

RELATIONSHIP

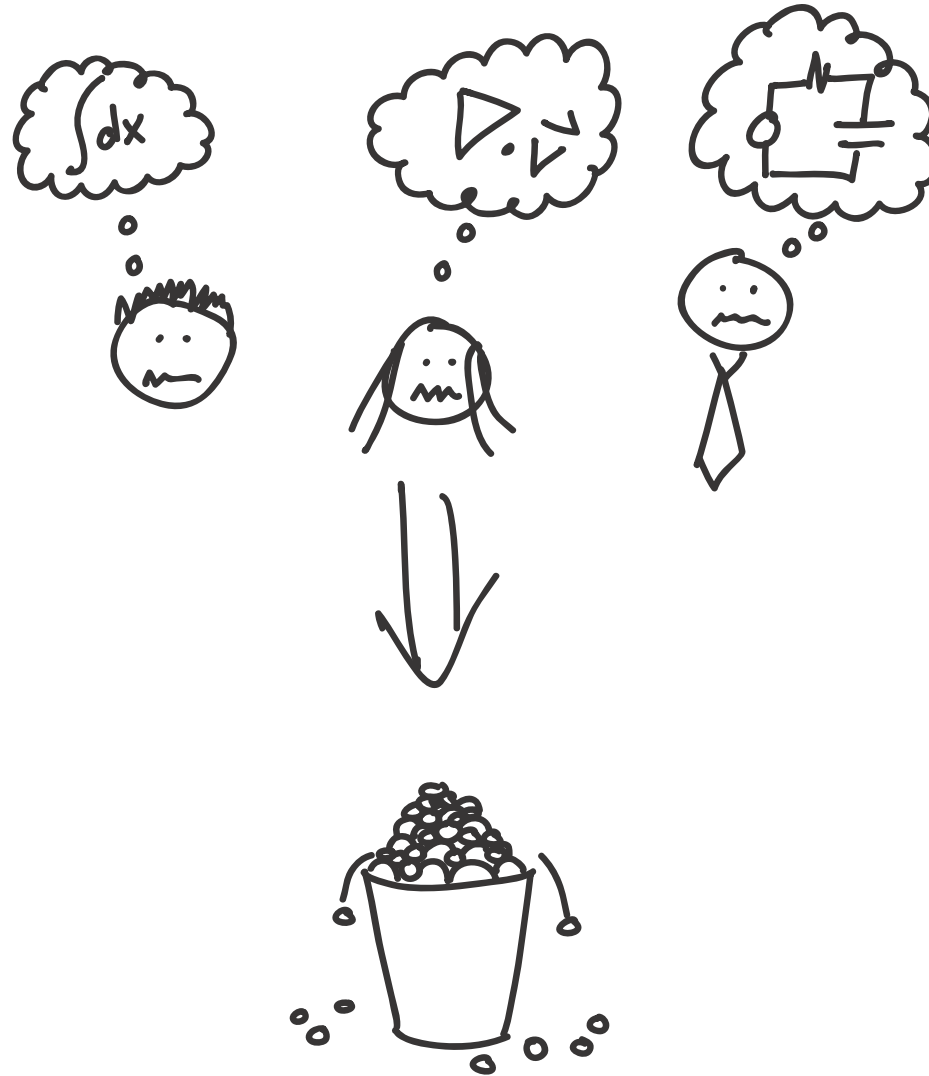
ASSUMPTION

RELATIONSHIP

2001



The idea: Big ideas should drive curriculum design.



The realities: There is only one blank slate;
Bottom-up, driven by topic X concerns.

2001

Seriously behind schedule.

1999

Meanwhile...

YOU CAN'T GET INTO



OUR COLLEGE . . .

. . . in 2000 because we don't exist—yet.

Franklin W. Olin College of Engineering won't open until the fall of 2001. By then, you'll probably be leading the fight song and grousing about your second-year housing at some other top-ranked college.

But don't toss this flier!

We're counting on you to pass it on to the 10th grader who ruins the curve in your AP physics class or the kid next

1999

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Seriously behind schedule.



2000



fearless?

*You like to take risks.
You love
the adrenaline
rush.*

*Maybe you're not ready
for the Indy 500.*

*But you may be ready for Franklin W. Olin College of Engineering.
After all, it takes courage and spirit to apply to a college that is
inventing itself. (The first freshman class arrives in 2002.) We'll make
it worth your while, though: every admitted student will receive a
four-year scholarship covering tuition and room, worth about \$100,000.*



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2001

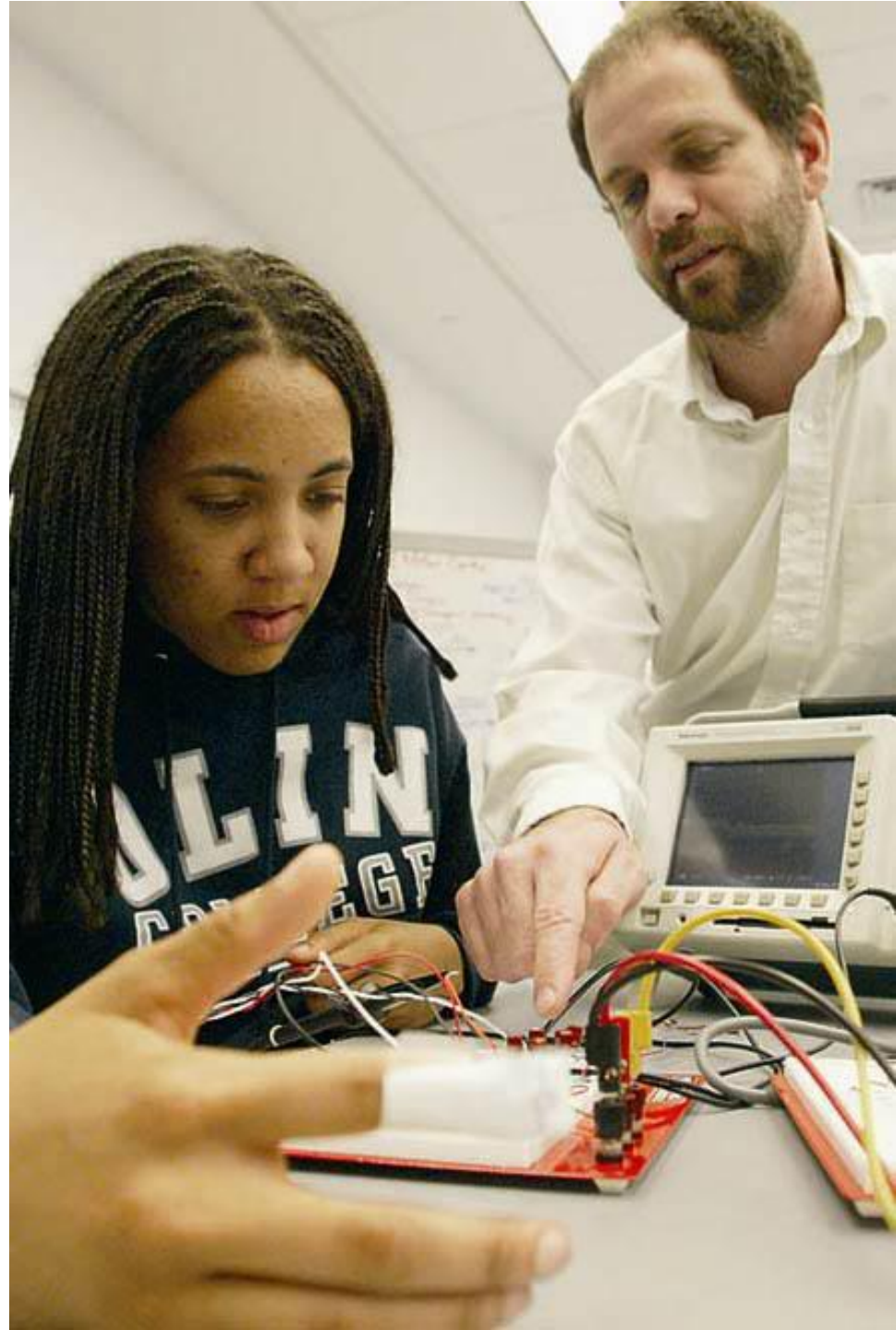


2001



2001

Students can do things
they shouldn't be able to do.



2001



“Now I know I can.”

2002

“Once Upon a College”

or

The Olin College Curriculum

(A Play in Five Acts)

*by The
Curricular Decision
Making Board*

2002



2002



2002



2002

Late buildings

Late and over-stuffed curriculum

Arguments galore

Lots of disasters

Today

Highly rated nationally

Gordon Prize for Educational Innovation

Applicants in top 1% nationally

Graduates going to top companies and PhD programs

Multiple successful startups

Visits by 150+ of institutions yearly



Princeton Review:
Hardest Working Students.
Happiest Students.

Pair discussion:

How could so much **success**
follow from so much **failure**?

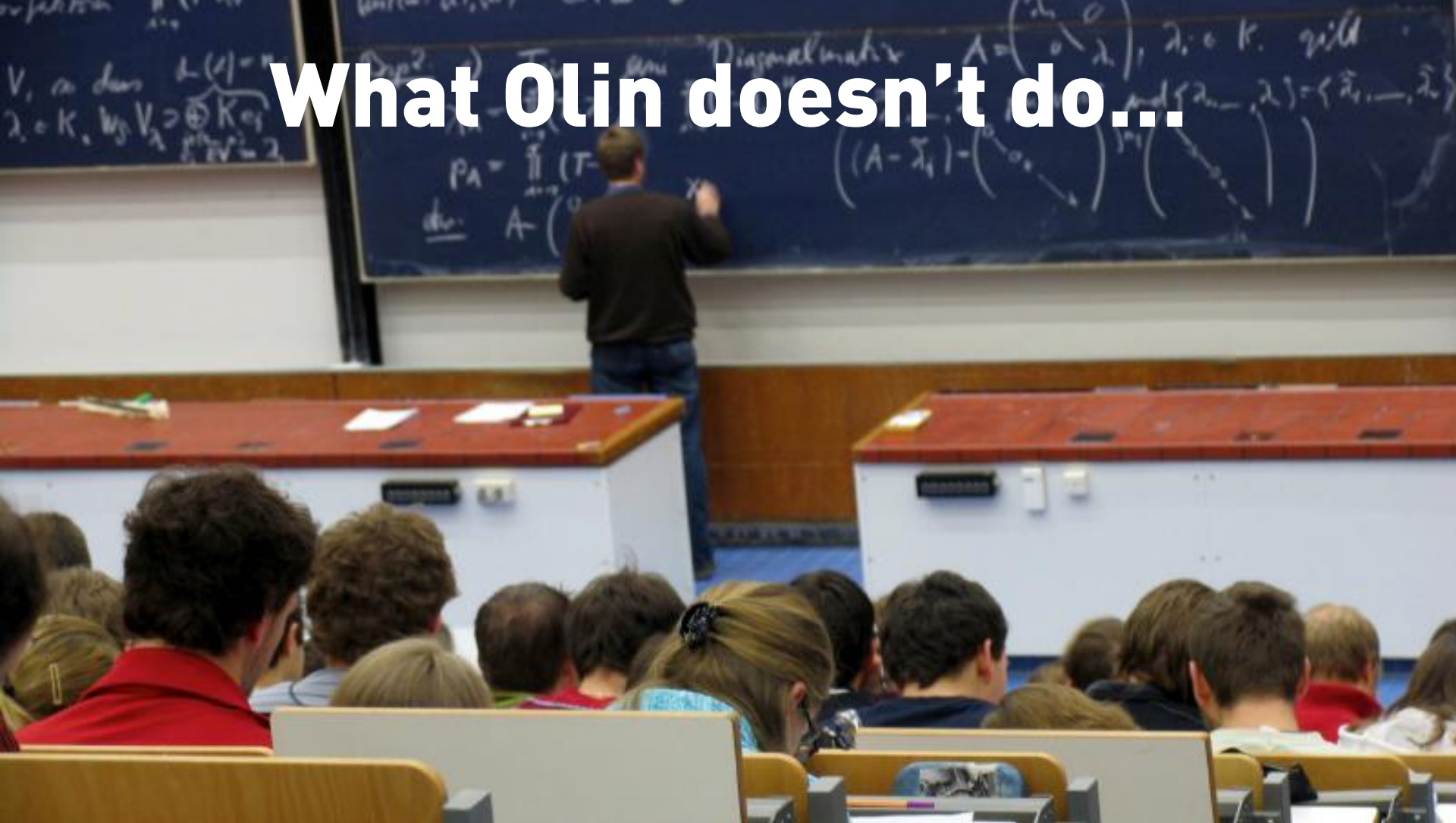
What made the difference?

debrief

WHAT MATTERS?

**Of course, curriculum is a
part...**

What Olin doesn't do...



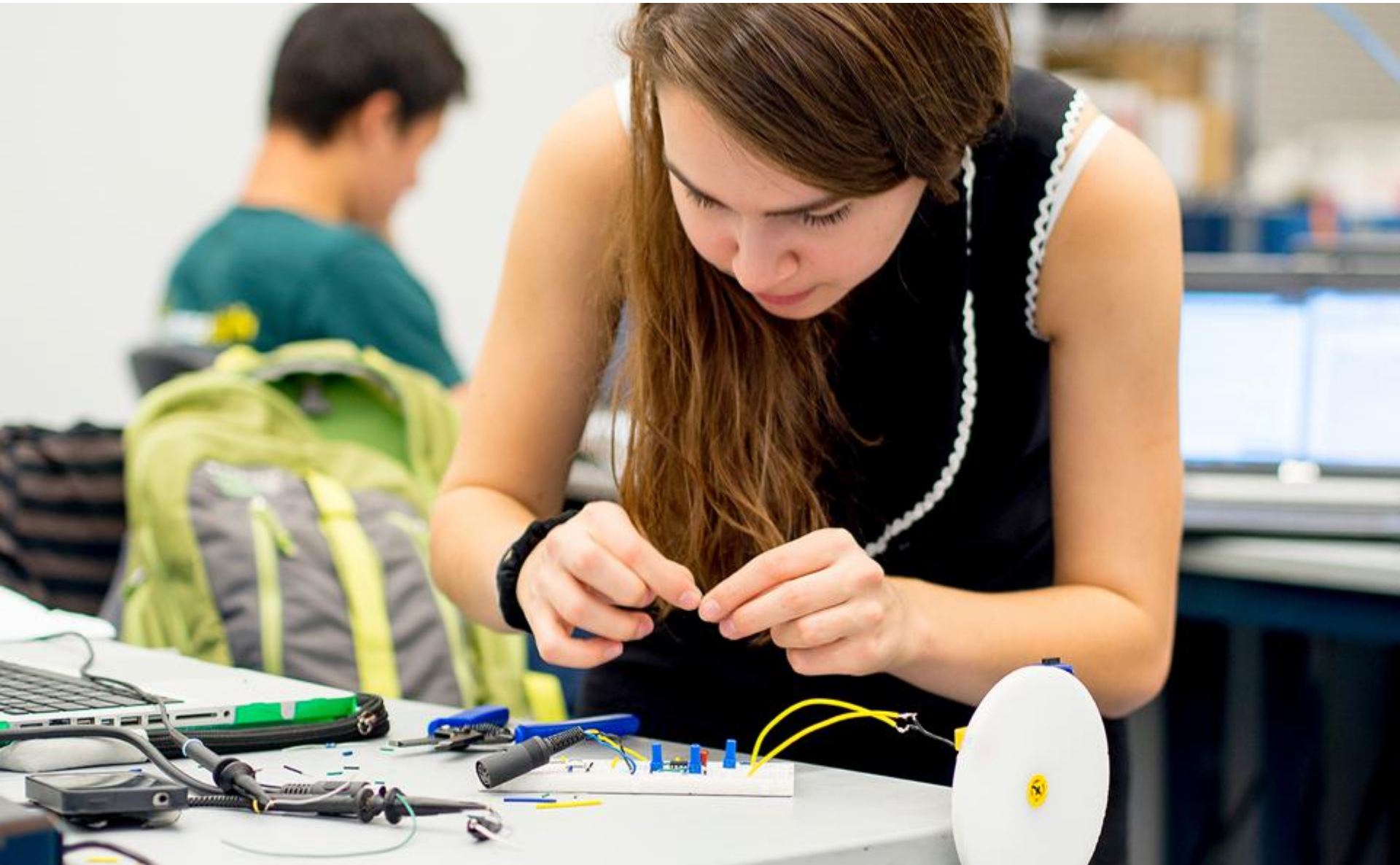
50% fewer “math / physics” and **major-specific** engineering science courses

Very few traditional examinations.

What Olin does do...

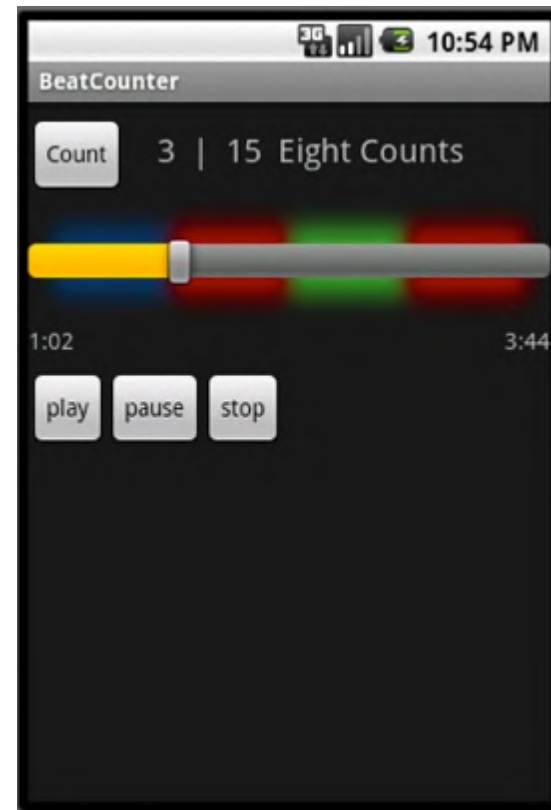
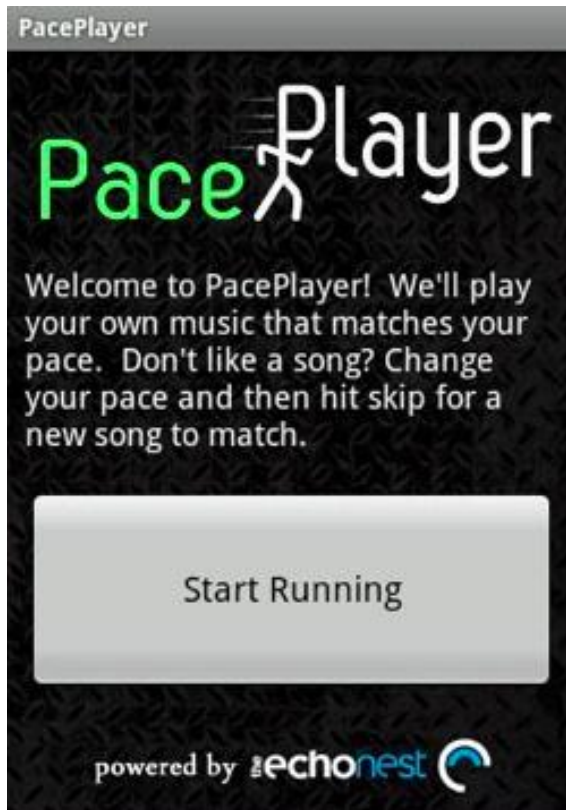
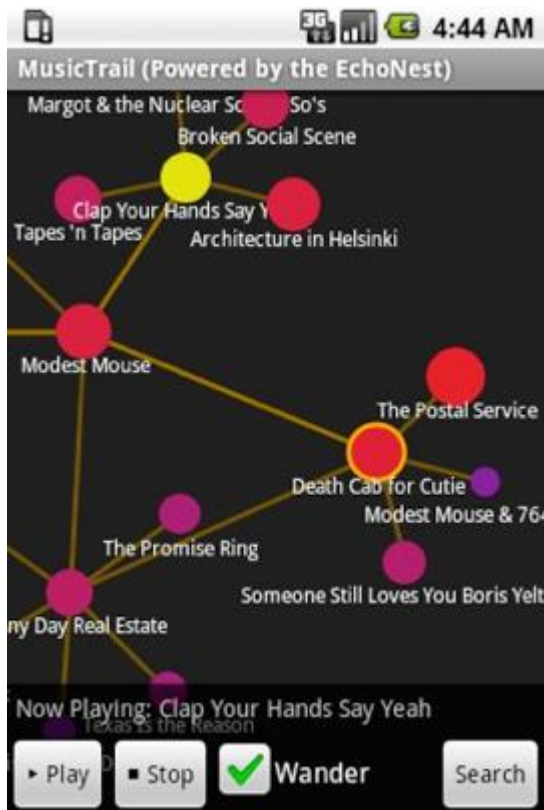


Our students **do** what engineers do...
from day one.





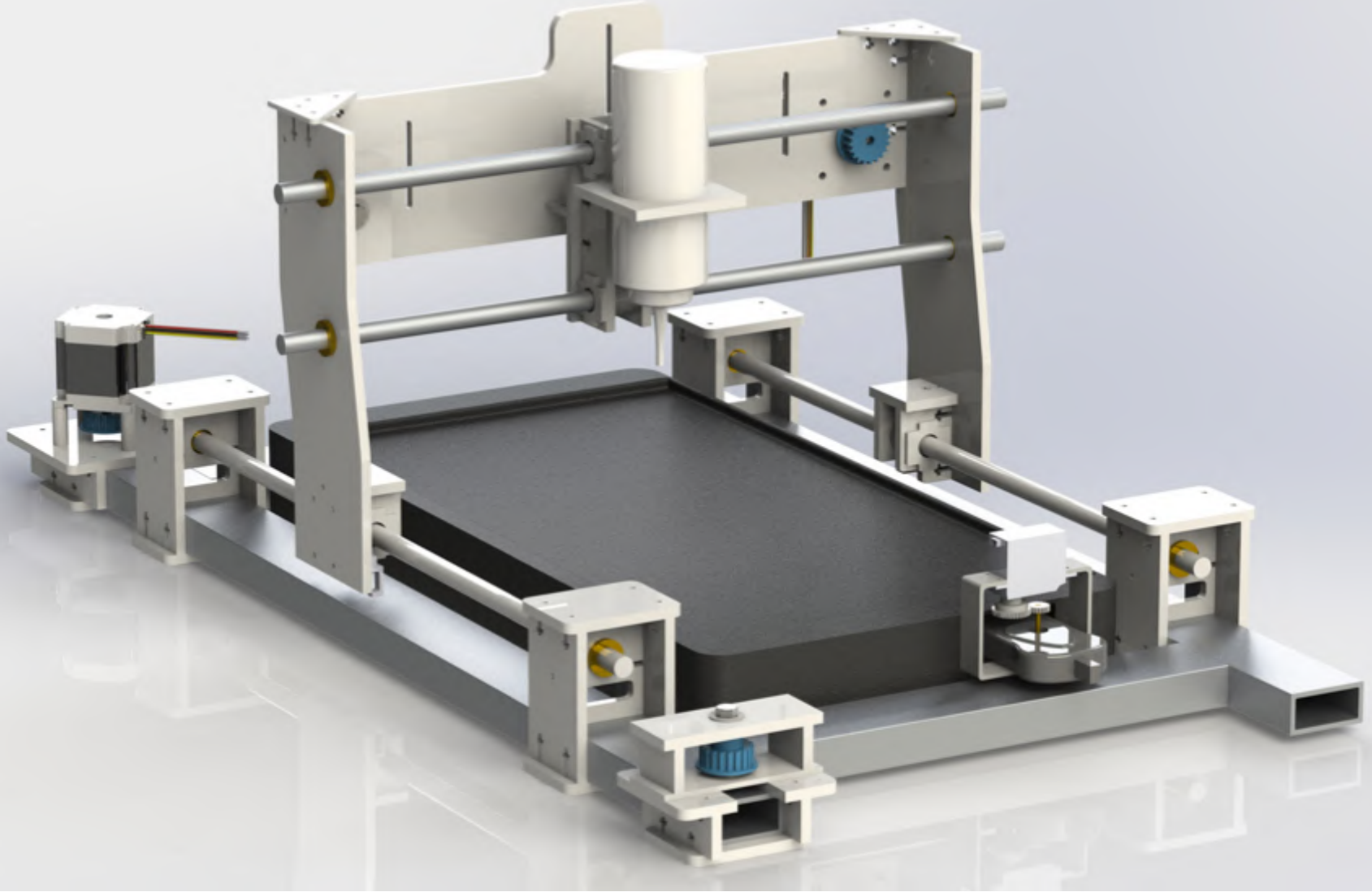
- 1) CLEAN UP
- 2) DECIDE POINTS
- 3) WEIGH IN
- 4) GO!





students **fail** and **reflect**.





“We had been so weight conscious in the design of this model that we overlooked its structural rigidity. As the model relied on our Teflon bushings being completely parallel to each other, the smallest amount of flex caused complete friction lock in the major axis.”

students do engineering that starts with
people.







students develop and practice
entrepreneurial **skills** and **mindset**.



Boilerless Espresso Machines

Traditional espresso machines keep several gallons of water hot but only ever use 2 ounces at a time. This means they are heating almost 200 times as much water as they need. By only heating the water being used, we can greatly reduce the environmental impact of espresso machines.

Easier to fix:

The machine not only contains fewer parts, they are cheaper and can be replaced in minutes

Consistent to brew:

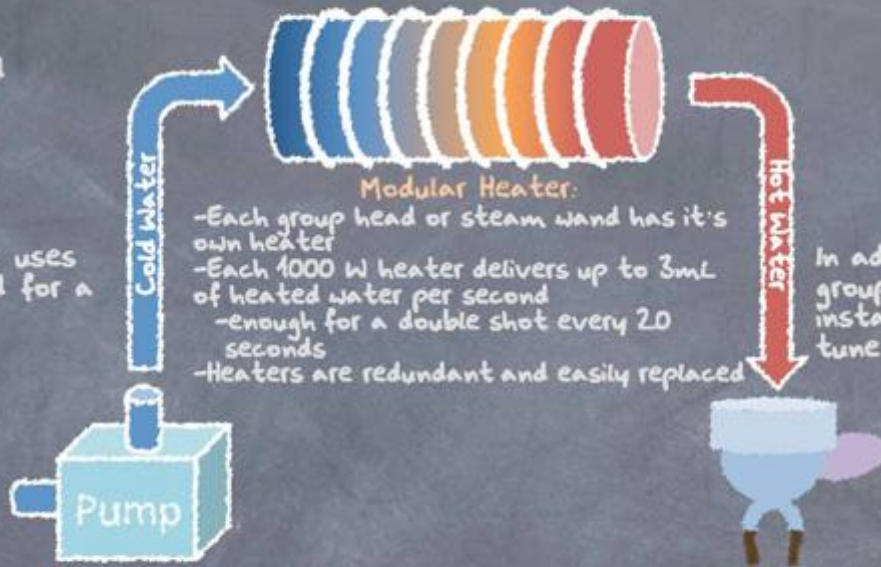
On demand heater with sensors means that no matter the frequency of use and environment, each shot will be the same

Cheaper to run:

Insulated on-demand heater uses a third of the power required for a traditional boiler

Reliable to operate:

Redundant robust design means that even if one group head or steam wand fails the rest will still work perfectly



Modular Heater:

- Each group head or steam wand has its own heater
- Each 1000 W heater delivers up to 3mL of heated water per second
- enough for a double shot every 20 seconds
- Heaters are redundant and easily replaced

Effortless to Tune:

In addition to instant-on, each group can change temperatures instantly, making it a dream to tune or experiment on

Green to boot:

Lower power usage and fewer harsh materials make for a greener machine

Individual Pumps:

- Each group head has its own pump
- Small and efficient
- Pressure control for each group head
- Complete redundancy of systems

Consistent Coffee:

- No temperature drop during rushes
- Multiple groups and steam can be used at once without performance loss

Retrofit Machines



Cheaper, for recently customers who bought a new boiler based espresso machine



Shop Owner and Barista, Lives Coffee

- Power Savings
- Consistency
- Reliability
- Less Downtime

Favorite Features

Student, Barista/Bar Back, likes coffee



LYNNE

- Green
- Instant On
- Consistency

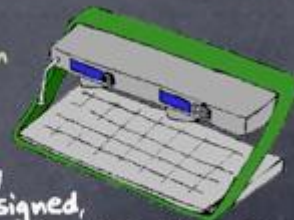


TIM

Pro-Barista, Loves Coffee

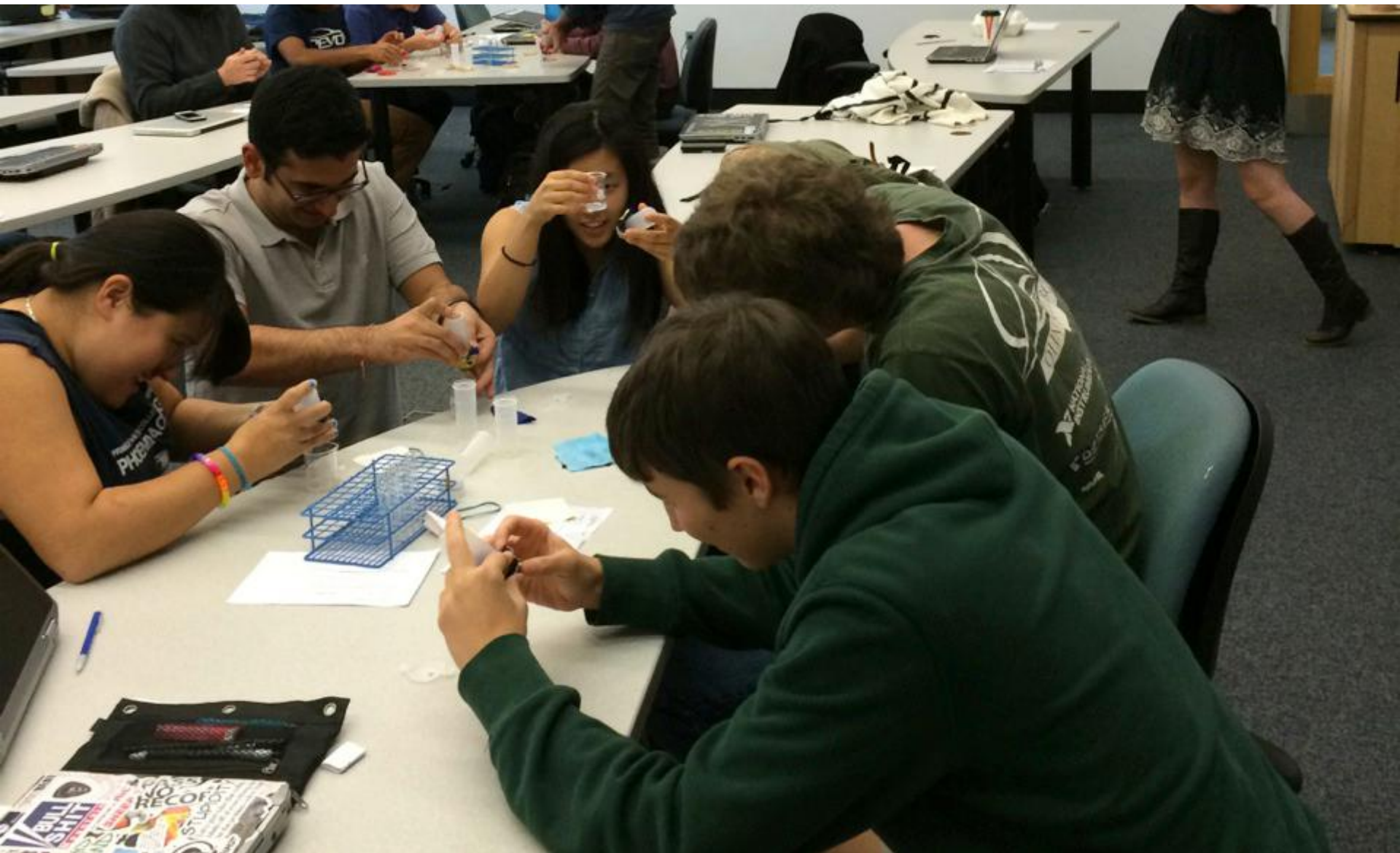
- Ease of Experimentation
- Consistency
- Green

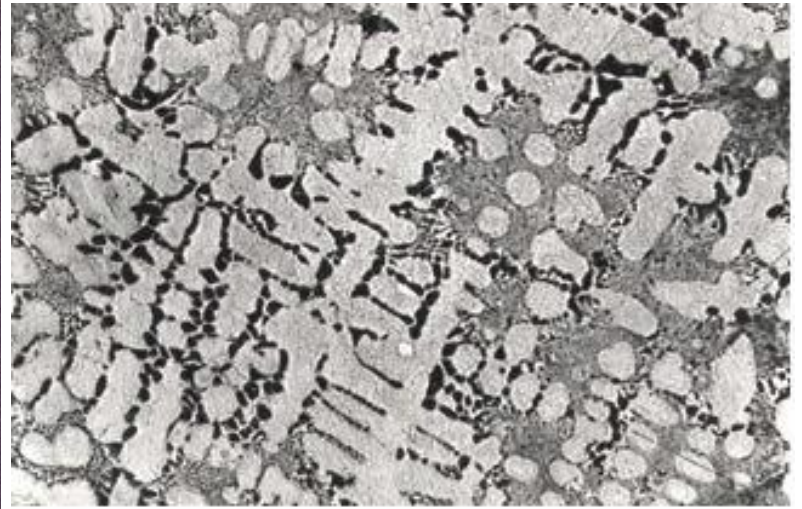
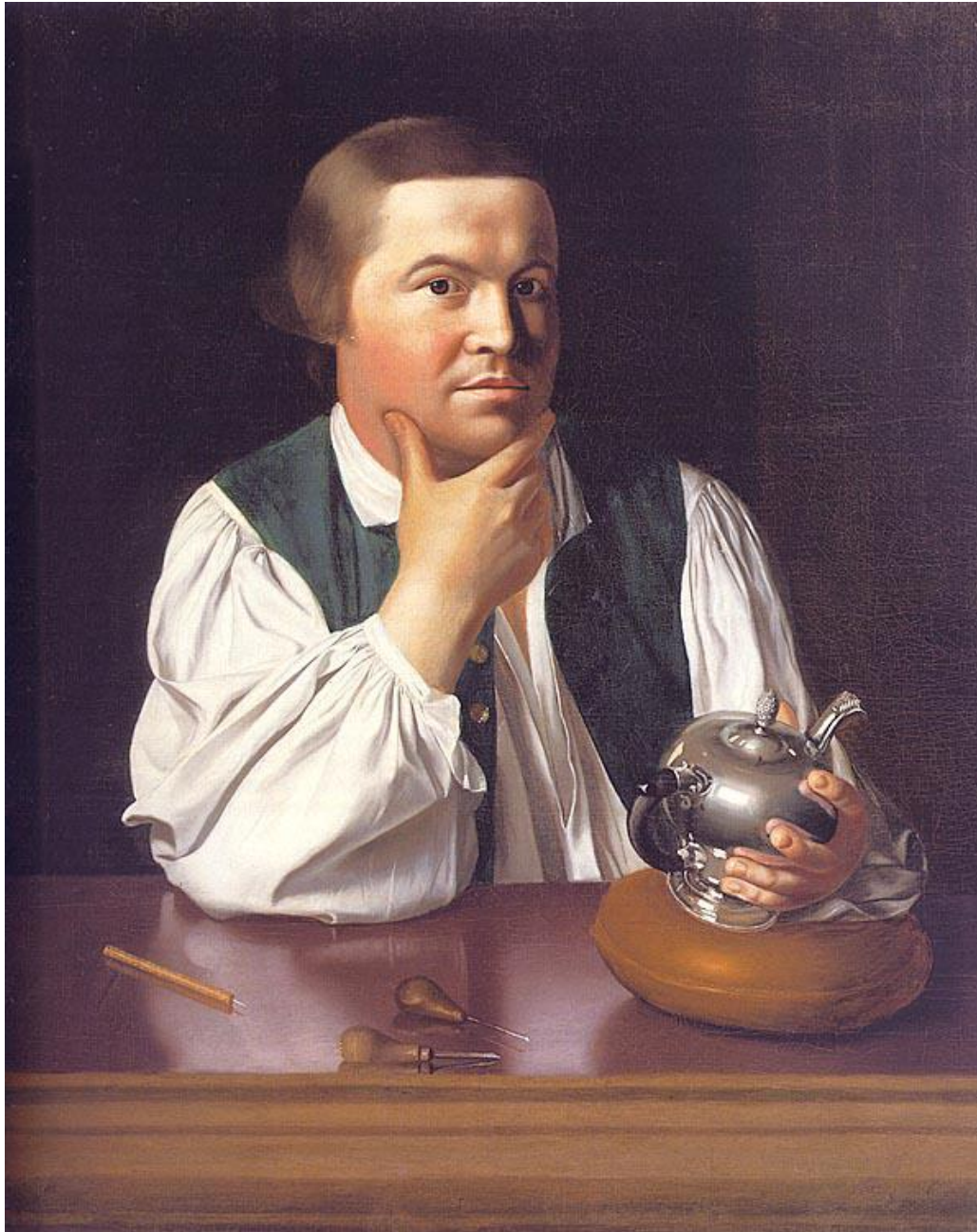
New Machines



Fully redesigned, for customers who are looking for a new machine

the student experience is highly **collaborative** and **interdisciplinary**.







ENGR3260 DFM

PLEASE DO NOT ERASE DOCUMENTATION PACKAGE

ITEM	DESCRIPTION	PART NO	VENDOR	QTY	UNIT COST	COST
1	FUSelage	CP-001	RED-EYE	1	\$256.00	\$256.00
2						
3						
4						
30	#4-40 SCREW	CP-030	MCMASER	25	0.001	\$0.025

← SURVEY + DOCUMENTATION →



our students are
co-creators.





Part B: Story Behind the Course Plan

If you are proposing a defined concentration, explain (a) why this is the best concentration for you and (b) how the courses listed on the other side of the form to fulfill your requirements.

If you are proposing a self-defined concentration, explain (a) how your proposed concentration (and the courses listed on the other side) incorporates breadth, depth, coherence, and (b) why you are interested in this area for more information.

You may attach additional papers or documentation if necessary.



A class on programming and web development at Olin College, Spring 2015

GitHub

Meets Tuesdays and Fridays 3:20–5:00 in AC326 ([Download iCal](#))

Office Hours

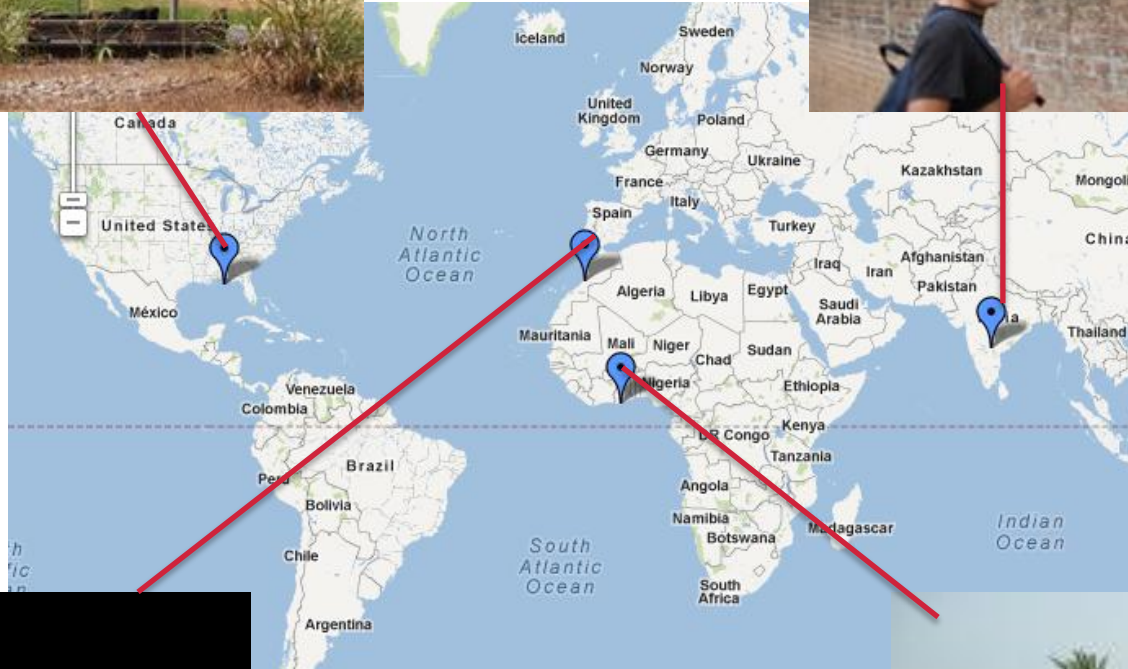
Mondays 8:00–10:00 in EH2 ([iCal](#))

Wednesdays 8:00–10:00 in EH2 ([iCal](#))

Thursdays 9:00–11:00 in EH2 ([iCal](#))

our students make an impact at Olin
...and **outside the institution.**





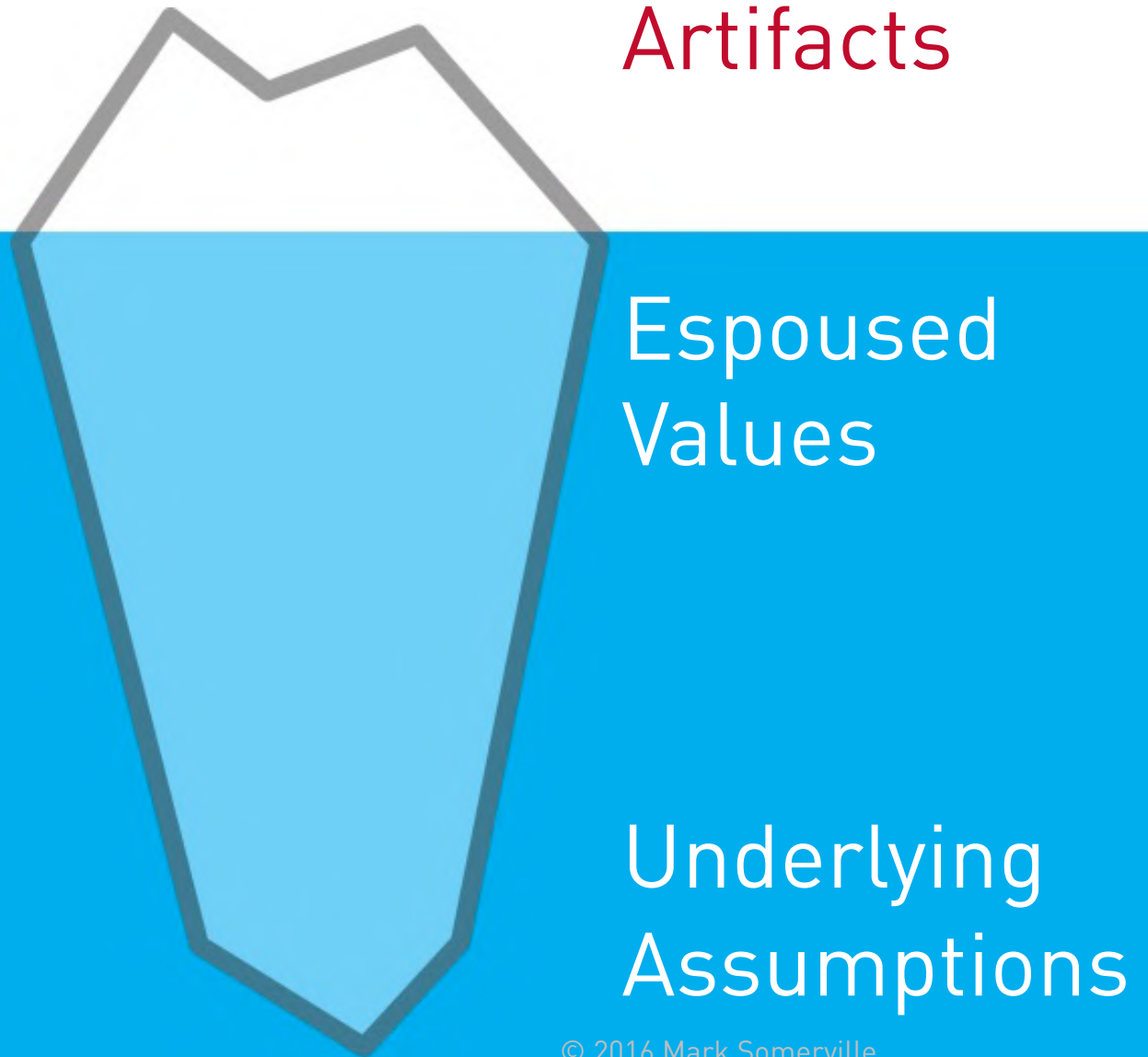
SPRA COUPE

4650



But if we **only discuss
curriculum, we're missing
the point...**

Edgar Schein's Culture Model



Content
Curriculum
Pedagogy



Incentive Systems
Student Preparation
Job Market

Content
Curriculum
Pedagogy

Incentive Systems
Student Preparation
Job Market

Values and
implicit
assumptions
about students,
faculty, and
education

Trust

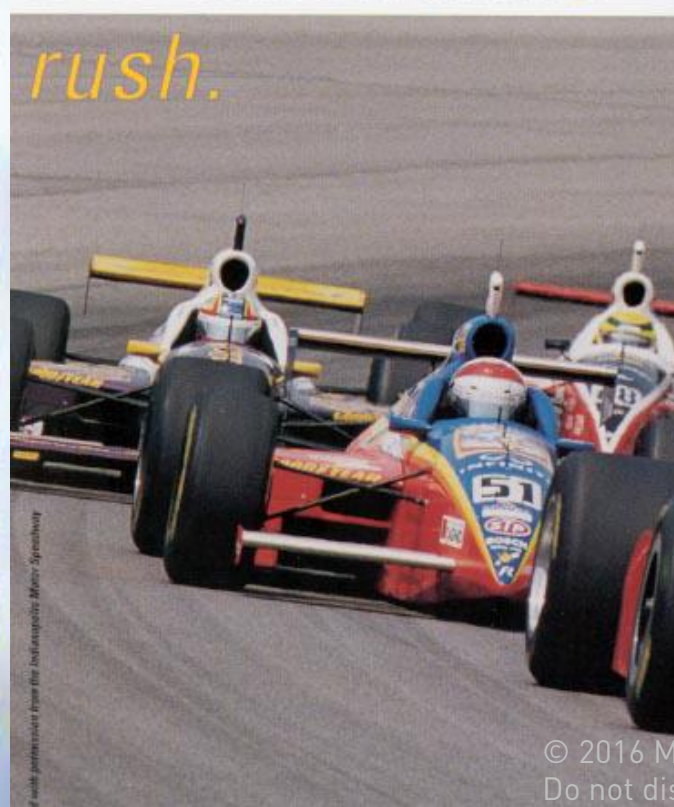




fearless?

*You like to take
You love
the adrenaline
rush.*

*Maybe you're not ready
for the Indy 500.*



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Courage

risks.

But you may be ready for Franklin W. Olin College of Engineering. After all, it takes courage and spirit to apply to a college that is inventing itself. (The first freshman class arrives in 2002.) We'll make it worth your while, though: every admitted student will receive a four-year scholarship covering tuition and room, worth about \$130,000.





Openness

Connection





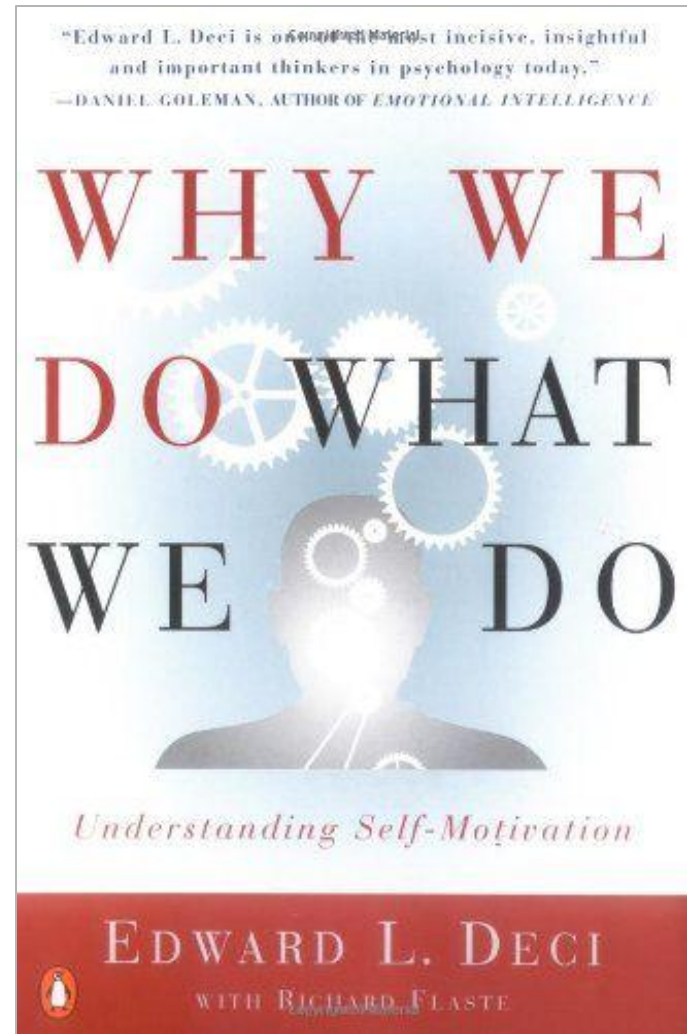
Joy

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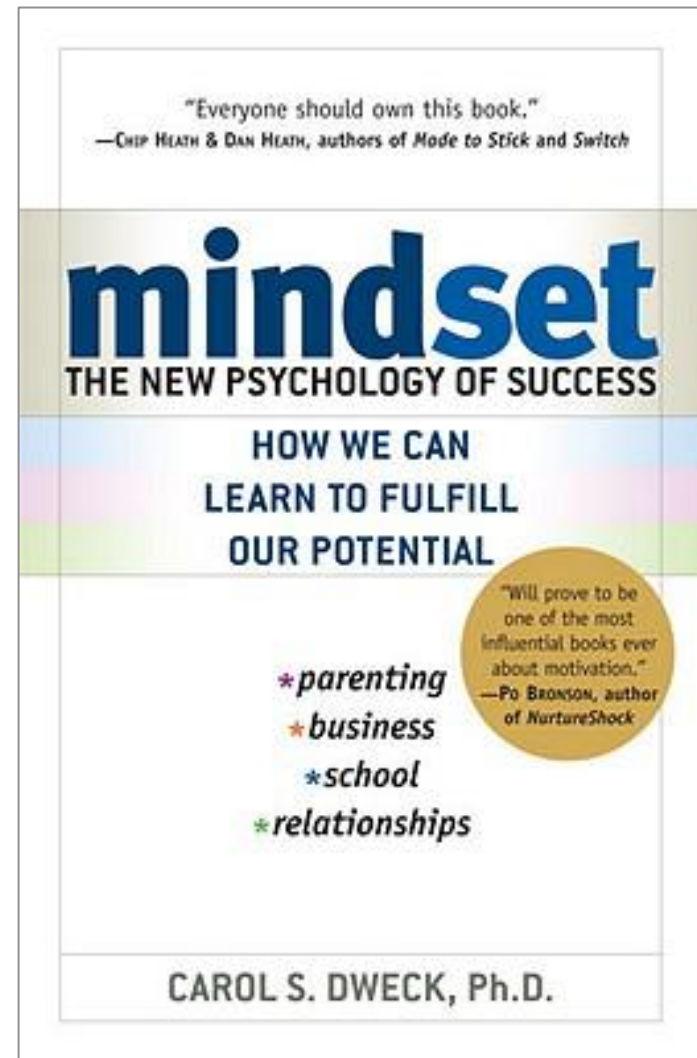
These are emotional variables.

**But as underlying
assumptions, they are
consistent with a culture that...**

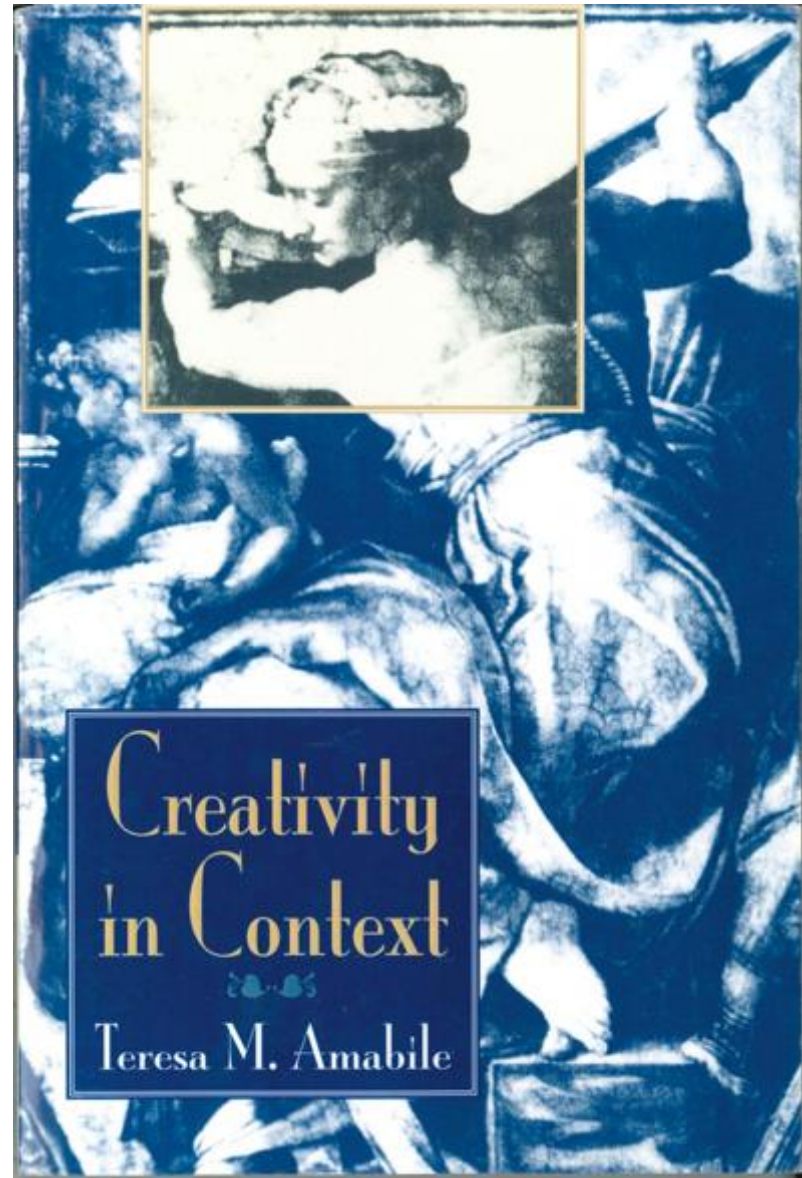
supports
**intrinsic
motivation**



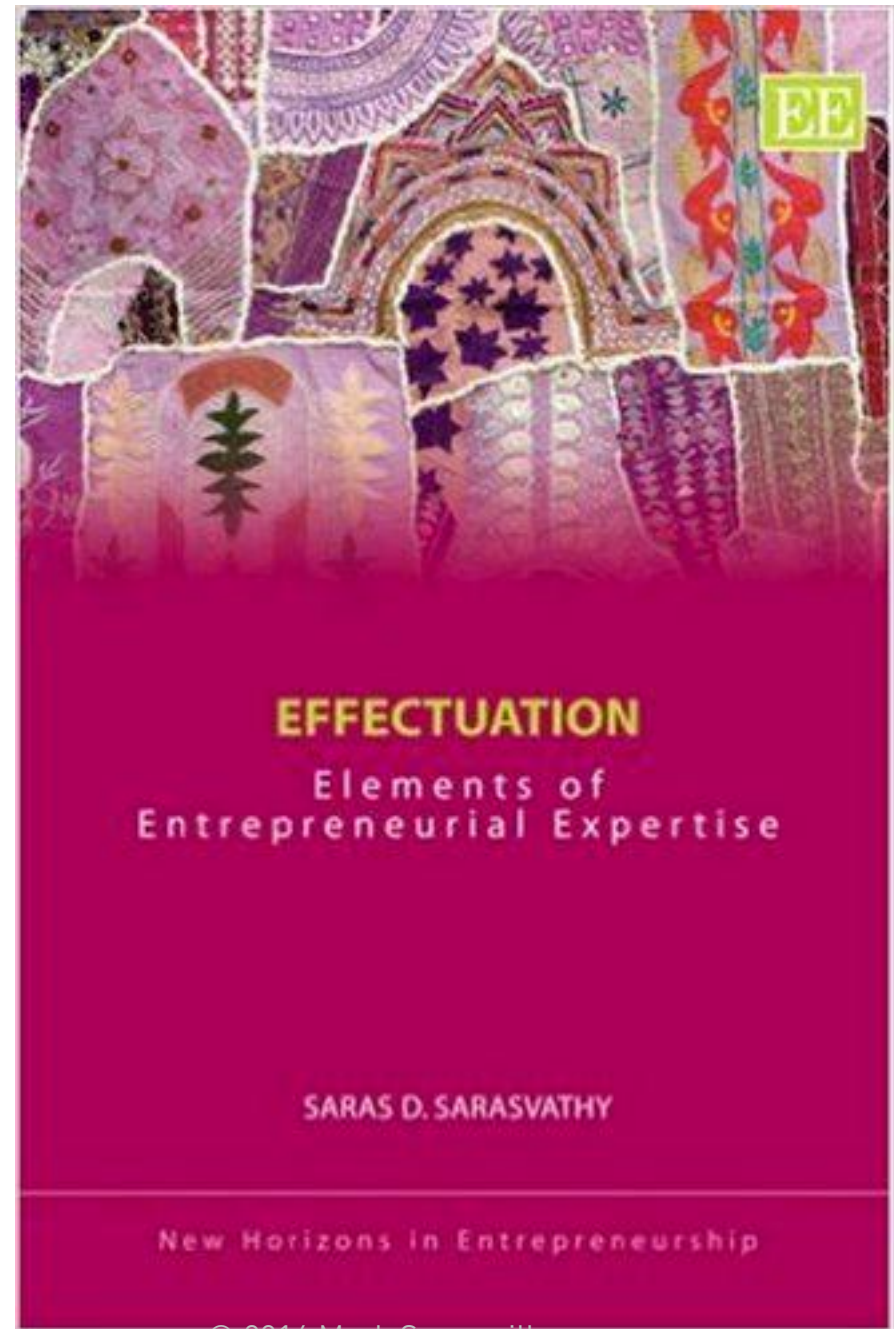
develops
**growth
mindset**



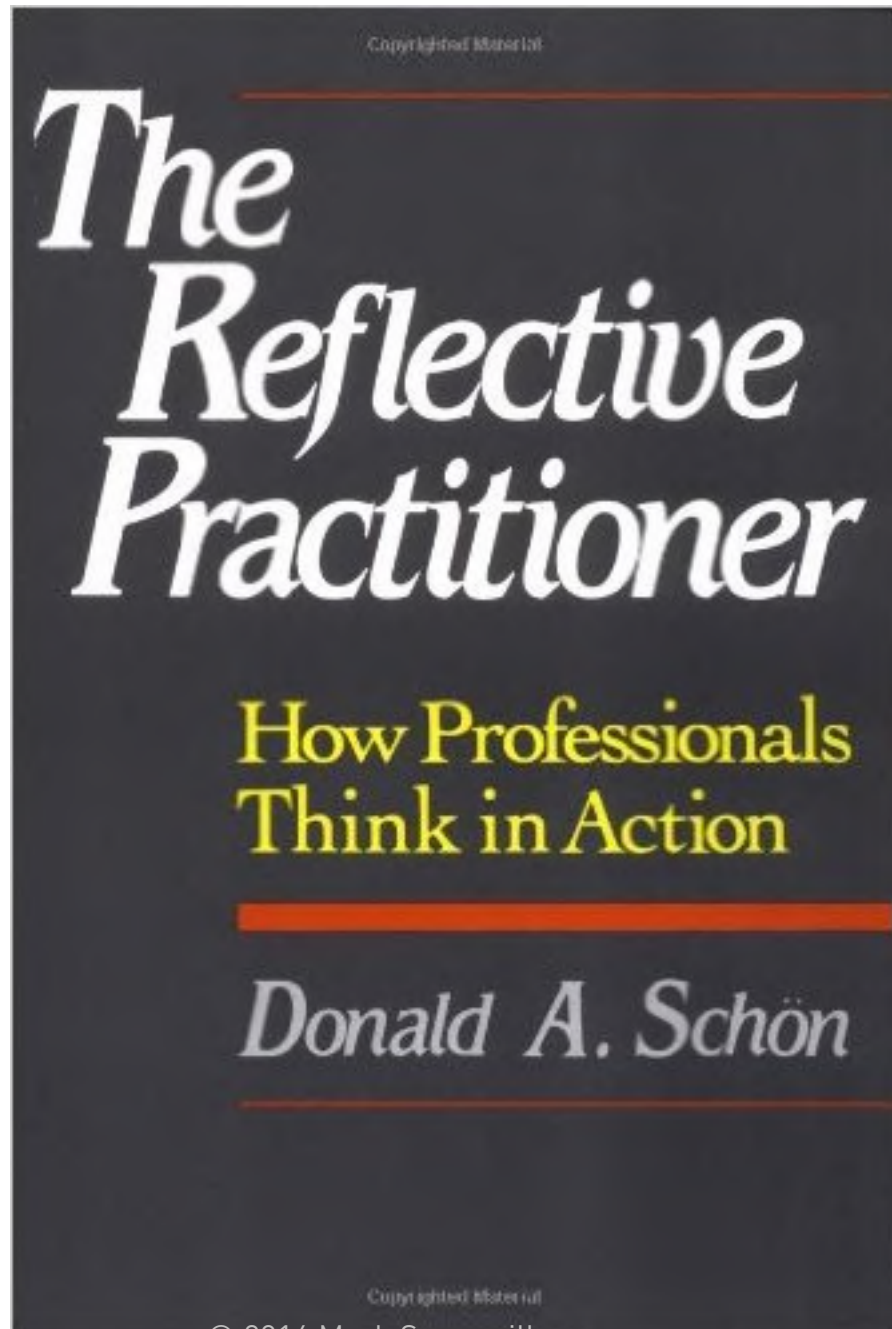
fosters
creativity



encourages
**entrepreneurial
thinking and
action**



promotes
**metacognition
and reflection**



But too often today...

Trust?



$\chi(T-\lambda)$
 V, n dann $L(V) = M_n(K)$
 $\lambda \in K, \forall V_\lambda \supset \bigoplus_{i=1}^m K e_i$
 $\dim V_\lambda = 2$

$(\lambda - \mu) \text{ Nullraum } \text{Rad } \oplus V_\lambda = V$ der $V = \bigoplus V_\lambda$ (loc. cit.)
 $(\lambda - \mu) \text{ LA II } \square$
Def 2 λ Eigenwert Diagonalmatrix $A = \begin{pmatrix} \lambda_1 & & 0 \\ & \ddots & \\ 0 & & \lambda_n \end{pmatrix}, \lambda_i \in K$ gilt
 $\chi_A = \prod_{i=1}^n (T - \lambda_i) = \prod_{i=1}^m (T - \lambda_i)^{n_i}$ $(\lambda_1, \dots, \lambda_r \text{ paarweise ungleich } \text{Rad } \{ \lambda_1, \dots, \lambda_r \} = \{ \lambda_1, \dots, \lambda_r \})$
 $P_A = \prod_{i=1}^m (T - \lambda_i)^{n_i}$
 der $A = \begin{pmatrix} \lambda_1 & & & \\ & \ddots & & \\ & & \lambda_i & \\ & & & \ddots \end{pmatrix}$



Openness?



Joy?

"The Student **cannot be trusted** to pursue his own scientific and professional learning."

"**Ability to pass examinations** is the best criterion ... for judging professional promise."

"**Presentation equals learning**: What is presented in a lecture is what a student learns."

"Creative scientists develop from **passive learners**."

"Students are best regarded as **manipulable objects**, not as persons."

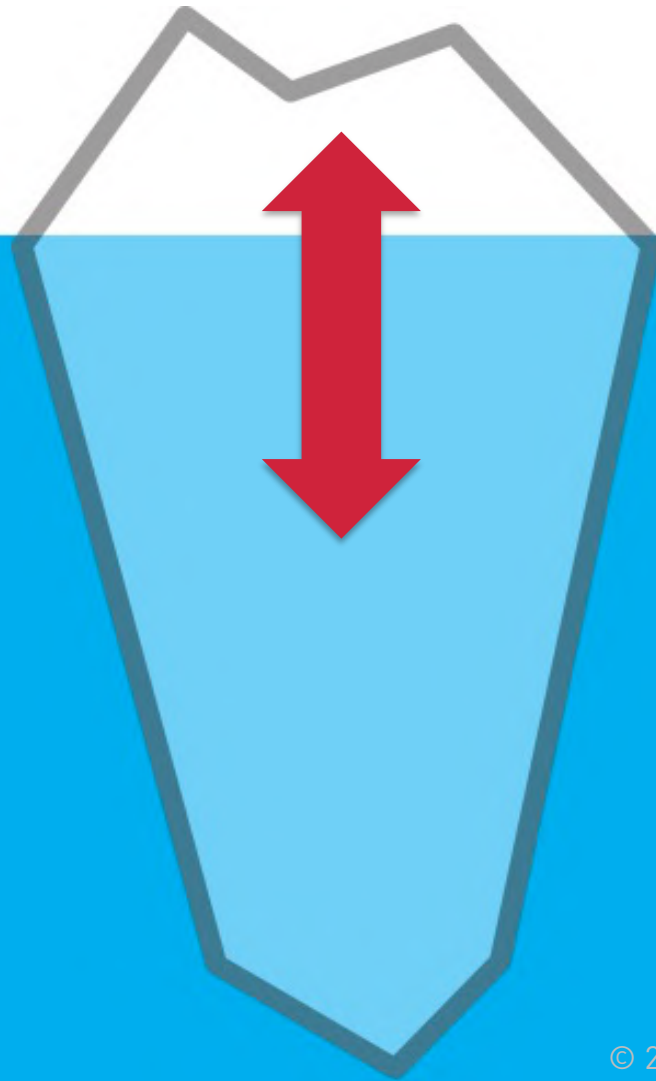
- Carl Rogers, *Freedom to Learn*

We need to change...

There is a growing concern that the engineering education system is failing to keep pace [with societal needs]... The structure and content has changed relatively little over the past 20 years.

(The Royal Academy of Engineering, 2007)

If we are going to get there, we need to work both below AND above the waterline.



Curriculum

Underlying
assumptions

Pair, then table, discussion:

What questions do you have?

What comments do you have?

What is the culture of your institution?

Table discussion:

“Don’t tell me you had a wonderful meeting...Tell me what you’re going to do on Monday that’s **different.”**

-Peter Drucker

Thank you!