Two Challenging Chemical Education Problems

**CHEM 341: General Biochemistry for non-biochemists**
- One-semester course with no labs/activities
- ~100 students/year
- Largest Upper-division science course
- Specific Course Challenges
  - Lots of content to cover
  - Pre-med students
  - Biology Majors: have not taken chemistry in ~1 year
  - Chem Majors: have not taken any biology in college.

**CHEM 105: Gen/Org/Biochemistry for pre-health majors**
- One-semester course with 11 labs/activities.
- ~300 students/year served
- Third largest course in Department
- Specific Course Challenges
  - No space is offered to all needed sections.
  - Some of the experiments could be done at home.
  - Some of the experiments could be done using virtual labs and simulations.
  - Labs are difficult to synchronize to lecture content.
INNOVATIVE APPROACH TO LEARNING

LABSTER IS A GLOBAL COMPANY THAT COLLABORATES WITH UNIVERSITIES AND INDUSTRY TO HELP EMPOWER THE NEXT GENERATION OF SCIENTISTS

3D Universe

Storytelling

Scoring

Reimagining and revolutionizing laboratory preparation through virtual simulations

Dedicated to developing interactive laboratory simulations
General Biochemistry Course: Labster Virtual Labs
Gamified Active Learning within an Immersive 3D environment
Cost per course:
- Approximately 70 virtual labs are available
- $10/lab or $45-90/semester for all labs.
- Waivers available for financial need students.

Within the environment:
- Open-Ended Storylines
- Mistakes are permitted
- No Health/Safety Risks
- No institutional resources required
- Provides labs when none can be offered
- Labs can be repeated for mastering skills
- Students can conduct labs on their schedule
Selecting the right Virtual Lab to examine: Course Learning Objectives and ACS Standards
Enzyme Kinetics Lab

**Reaction Setup**

**Molecular Visualization**

**Data Acquisition**

**Data Analysis**

**Theory, Guidance, and Assessment**

**Control Activity: Excel-based Data Analysis**
Labster Enzyme Kinetics: helps students **apply** concepts learned in General Biochemistry

**Pre-test:** Given before activity

**Mid-test:** Given after first activity (before swap)

**Post-test:** Given after second activity (after swap)

**LF:** Labster activity first group

**EF:** Excel assignment first group
Student Comments and Effects on Intrinsic Motivation and Self-Efficacy

- "The virtual lab exercise helped to understand the material."
- "Labster was a great means for interaction since there was no Lab"
- "Labster assignments gave a hands-on feel to grasp information"
- "The virtual-labs were interesting and helpful "hand-on" experience"
- "the online lab took too much time away from other assignments/ classes"
- "The Labster's are great. They enabled me to understand things from a different perspective. Thanks for providing this service to us!"

Intrinsic Motivation

[Bar chart showing changes in intrinsic motivation levels before and after Labster usage]

Self-Efficacy

[Bar chart showing changes in self-efficacy levels before and after Labster usage]
Proposed Solution for GOB Chemistry Course

- Replace ~6 traditional labs/activities with Labster virtual labs and/or take-home experiments.
- Distribute remaining 6 in-class labs throughout the semester.
- Purchase reusable equipment for at-home lab experiments.
- Design safe experiments for students to do at home.

Red highlighted Text indicates content not yet covered in lectures but necessary for that week's lab.
Red Filled boxes indicate in-class labs that were misaligned with lecture content coverage.
Orange filled boxes indicate aligned in-class labs.
Green filled boxes indicate aligned home-based labs.

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LABSTER
Customized Take-Home Lab kits for GOB Chemistry

COST ~ 30$

Equipment
- Pocket Scale
- Rulers
- Graduated Cylinders
- Modeling Kit
- Syringes
- Digital Thermometer

Reagents
- Anti-oxidant
  - Vitamin C
- Oxidizer
  - 2% Iodine
- Substrate
  - Corn starch
- Enzymes
  - Red Cabbage
  - Yeast
- Substrate, Carb
  - Potato
  - ovalbumin
- Spat
- pH Indicator
  - Red Cabbage
- Protein
  - Olive Oil
- Acids
  - Vinegar
  - Lemon Juice
- Bases
  - Baking Soda
- Lipid
  - Argo

Cost ~ 30$
Students can easily adapt to innovative technology with the following recommendations:
- Introduction during first classroom lecture
- Clear instructions delivered in a presentation and followed by email
- Via Announcement post in LMS platform

Communicate on four (4) key points:
- Overall expectations
- Course Set-up
- Timeline
- Benefits
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LABSTER simulations are **inquiry-based**, students must identify, process and then apply necessary skills to complete their mission.

Source: Nature Biotechnology 2014, controlled study with 160 students from Technical University of Denmark and Stanford Online High School.
IMPROVING LEARNING

76% learning outcome increase

Labster provides online virtual learning simulations with 76% evidence-based increased learning outcomes for STEM education\(^1\) at a fraction of the costs.

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\(^1\) Source: Nature Biotechnology 2014, controlled study with 160 students from Technical University of Denmark and Stanford Online High School.
A GLOBAL START-UP STORY

LABSTER.COM

DTU Student Project

2010

Labster ApS Founded

2011

Labster 2.0 Platform Development

2012

Reimagine Education Award

2014

The Future

2015

Labster 2.0 Platform Development

2016

$3 million in grants

2017

About 54 simulations

About 16 simulations

GOLC Award for Best Simulations
LABSTER VIDEO
www.labster.com

GAD 1  08:00 AM  PROGRESS:  50%

Pipette a drop of water onto the circles of Elpon card 1. Click here for more information.
OVERVIEW
LABSTER SIMULATION DEVELOPMENT PROCESS

1) Flow Overview and Assessment
2) Base XML
3) Alpha Development
4) Art Assets Development
5) Beta Development

Release Candidate
Proof reading Final Test
Launch Simulation

Quality Assurance

Writers
Platform Developers
Developers
Artists

Developers

Quality Assurance

Candidate