A model for open-ended “dorm room” physics experiments

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AAPT Winter Meeting

ILLINOIS

We begin with some context:

Many different reasons and roles for experiments at home

- Distance learning
- Hybrid classrooms

Hybrid physics labs at University of Illinois:

- Part of introductory mechanics lab reform
- In third semester of pilot phase with 100-160 students

Dorm room physics as a part of lab reform at Illinois

Prelab assignment: Students do experiments at home with online prompts

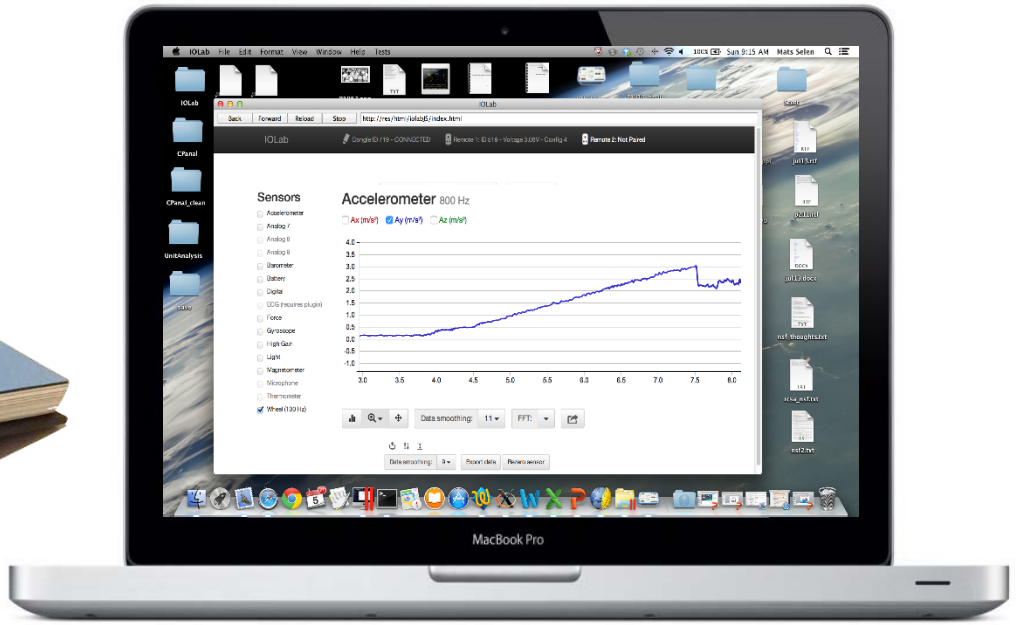
Instructor provides email feedback prior to class meeting

In the lab: design tasks in the classroom build on prelab experience

Two key technological components:

Every student has their own lab equipment

Interactive Online Laboratory (IOLab) system



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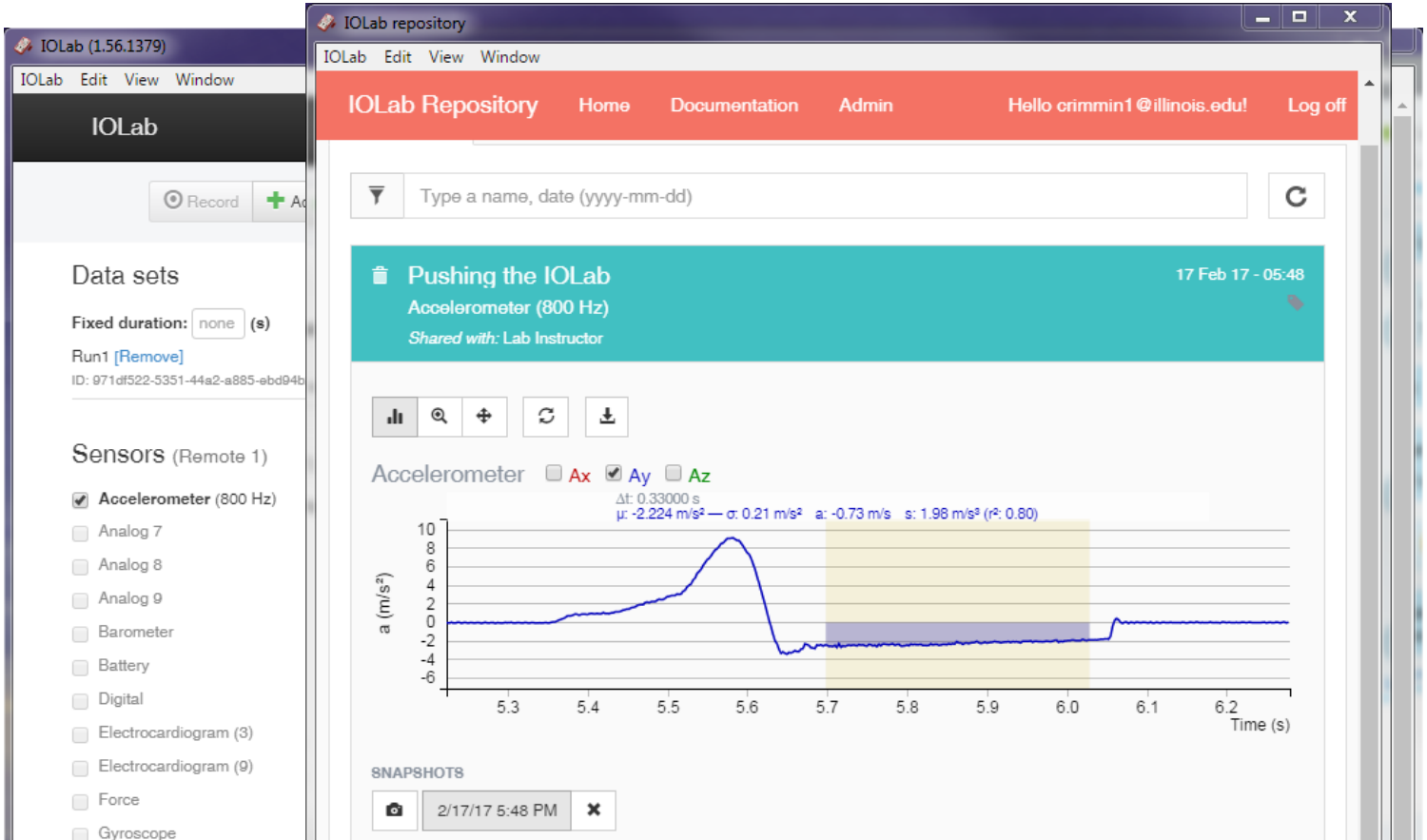
Students can share their data in the cloud



How do we approach dorm room experiments?

(a) Summative:

- Extensive instructions and specific questions
- Focus on getting a specific result from an experiment

(b) Formative:

- Open ended questions
- Many results or solutions occur
- Focus on developing basis of experience for future instruction

Example from Spring 2016: early in semester

Prelab objectives

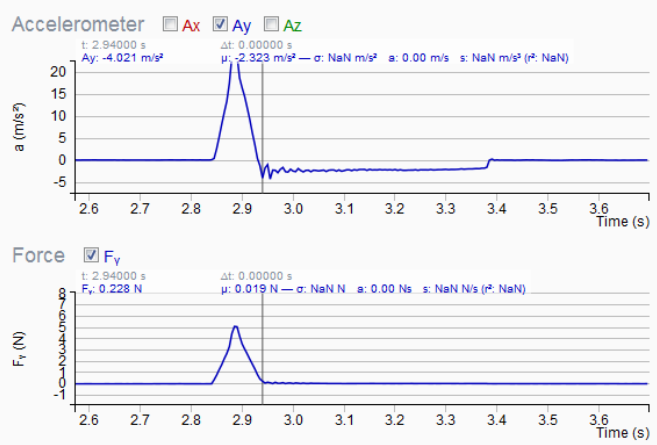
Activity 1

Collect data with different sensors and extract information

Activity 2

Consider a feature in a graph from previous class

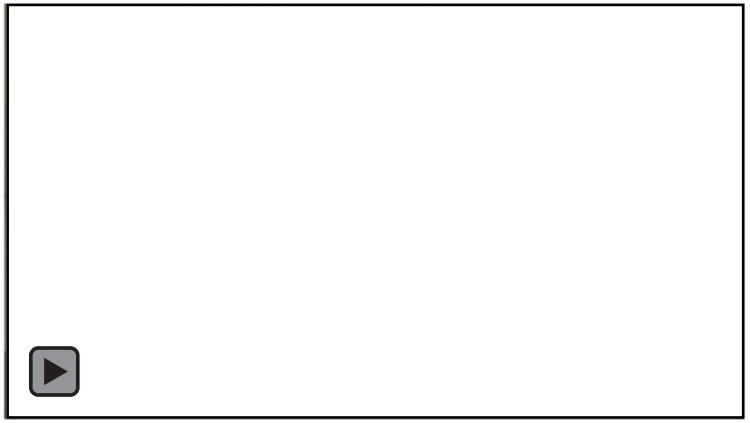
Lab



Activity 1:

In this activity, you'll begin to consider the different ways that you can understand a physical system using the tools that are available to you.

Attach the spring to your force probe. Using your finger, apply a few quick horizontal impulses of varying strength on the end of the spring so that the IOLab remote rolls in the +y direction each time. An example of this motion is shown in the video clip below.



1) Which sensors can you use to record information about the action described above?

2) Take a look at your data. What are some things that you can find out using this data? List a few below.

3) Choose one of the items from the list above and actually find that thing out. Describe what you did and what you found below.

Student responses vary

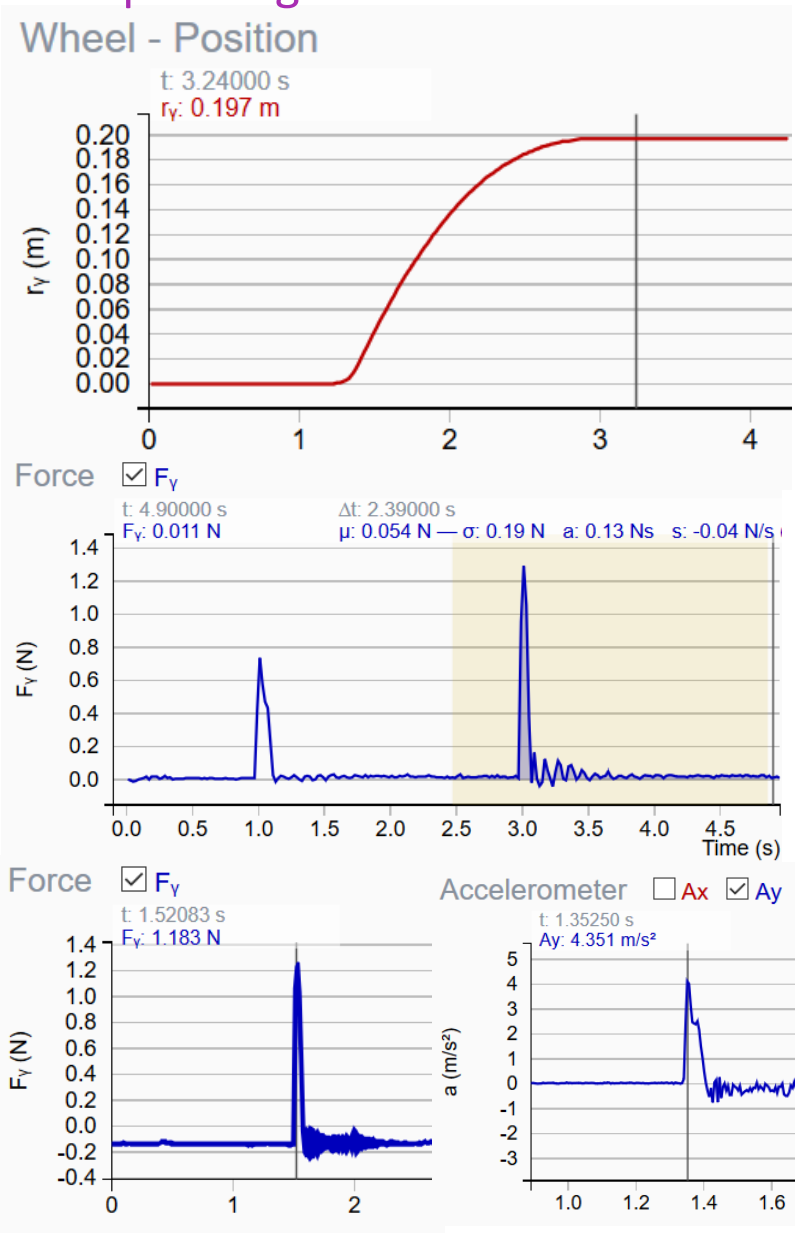
Student written examples:

Surface features
Read directly from graph
"Using the Wheel sensor we can easily find out the distance is moved by looking at the graph. It moved a total of .2m"

Software analysis
Calculation done in IOLab software
"In the force test, the average amount of newtons exerted on the vehicle in the second test was 0.055 N"

Outside of Software analysis
Calculation or connection made by student
"We can do F=ma, and through that, we can take the average force and the average acceleration in the y-direction, and found that the mass is equal to .3kg."

Corresponding shared data:



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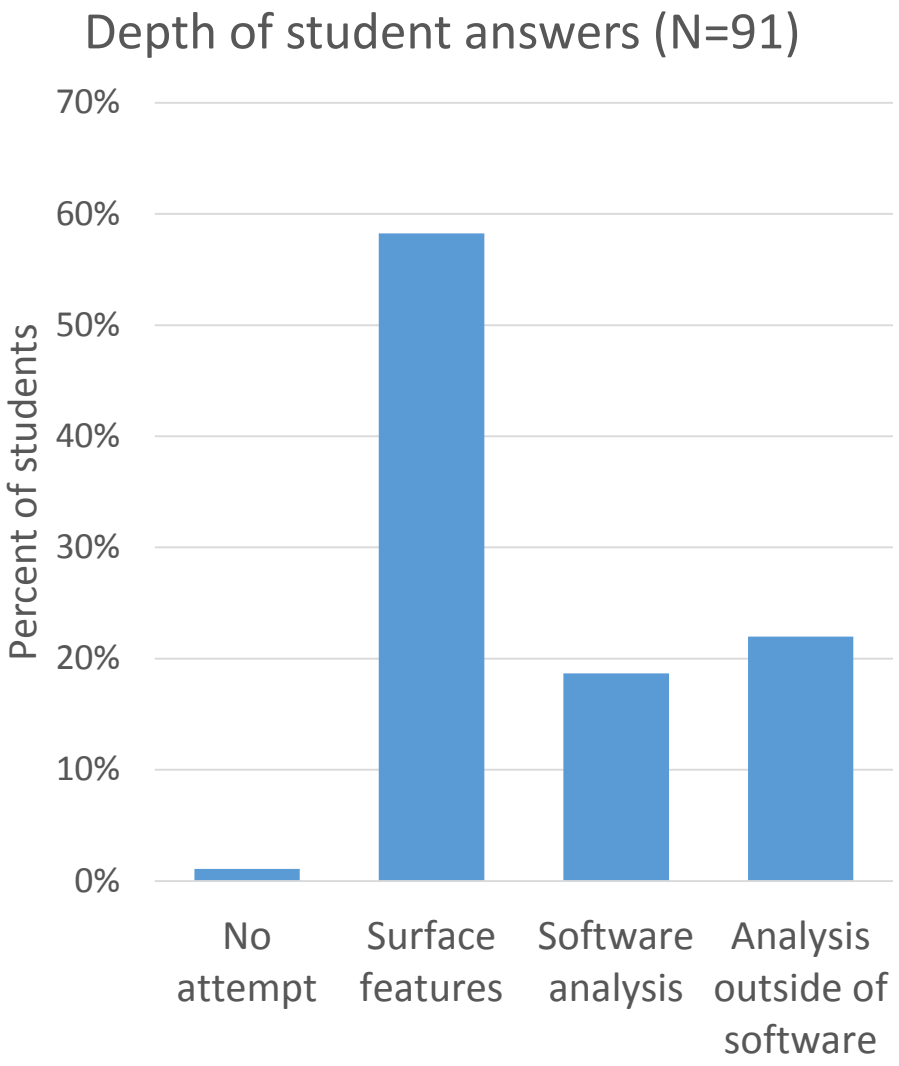
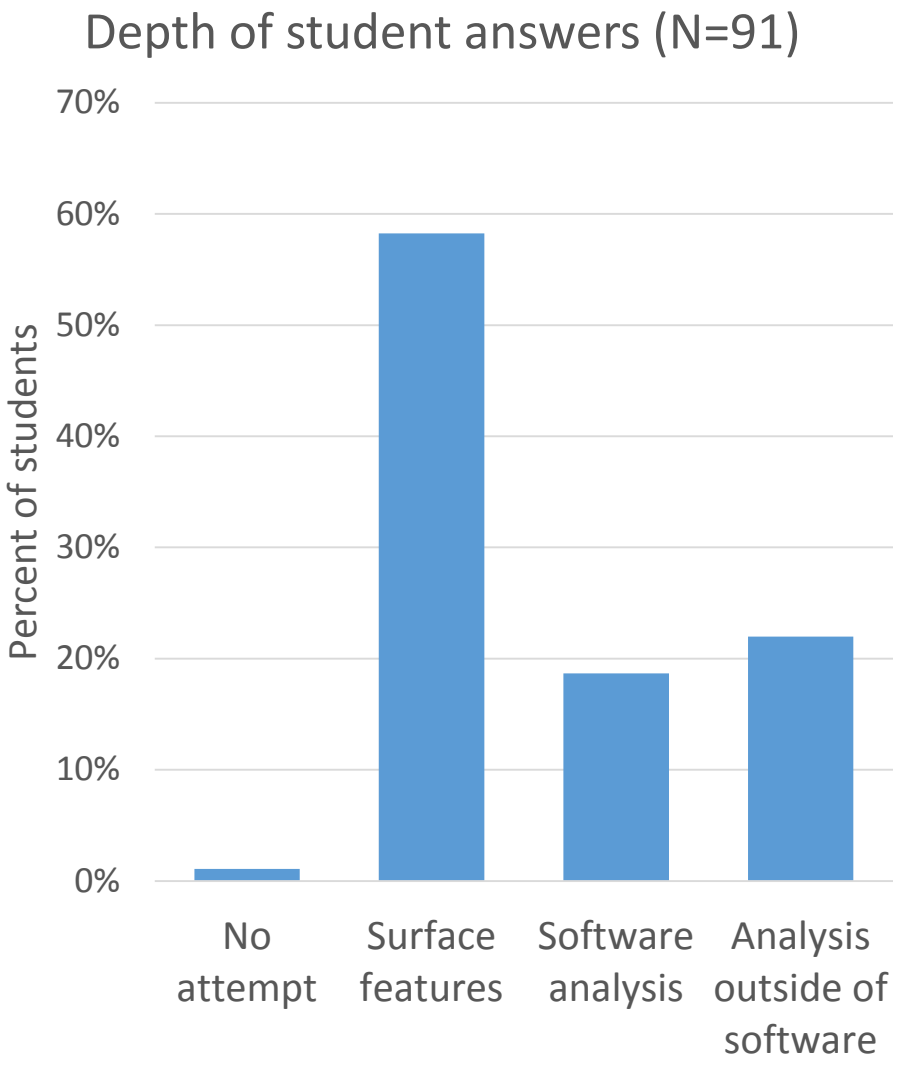
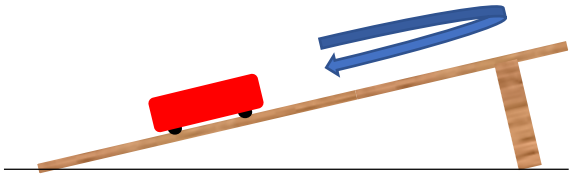


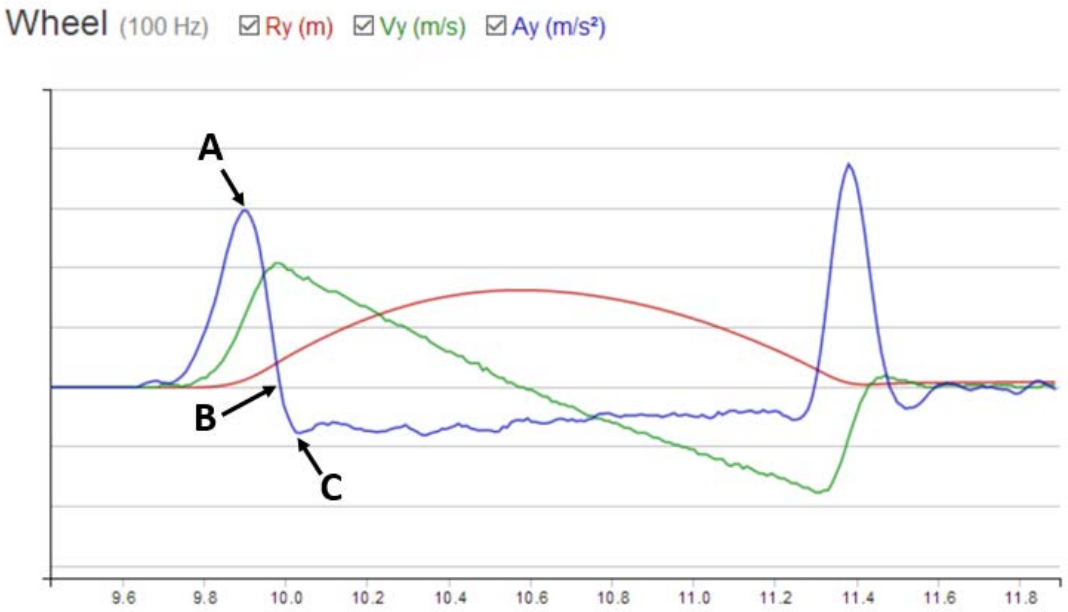
Student responses vary

99% of students are interpreting their data



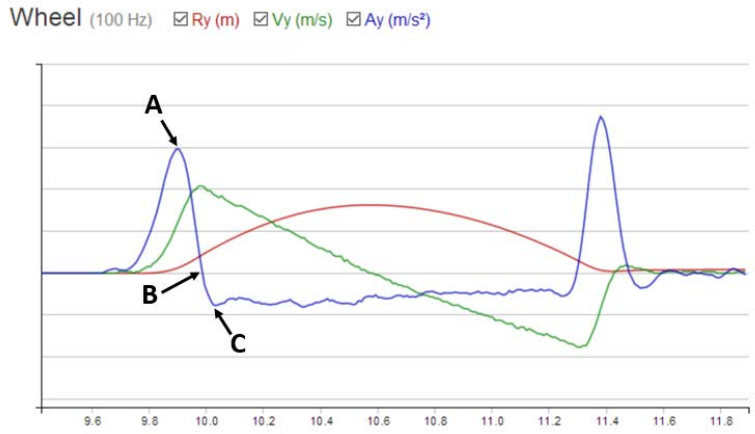
Activity 2: Reflection from previous lab

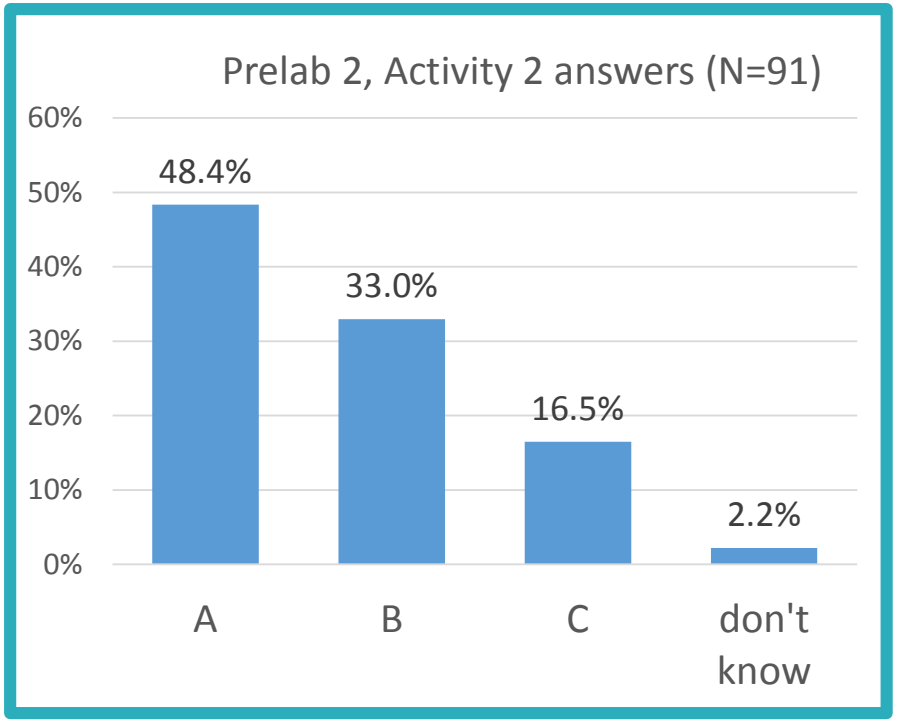




After rolling the IOLab on the ramp your group cannot agree: At which point do you think your hand lost contact? Using the data, justify your answer.

Student answers tell us where they are





"A, because acceleration is highest when the hand is still pushing the IOlab, and after you stop putting force on it is when it can slow down."

[B] "The force applied when pushing = mass x acceleration, and so when the force is taken away, the acceleration is also taken away."

[C] "You are applying force which causes it to accelerate. Once it goes back down the ramp there is negative acceleration due to gravity."

Example from Spring 2016: early in semester

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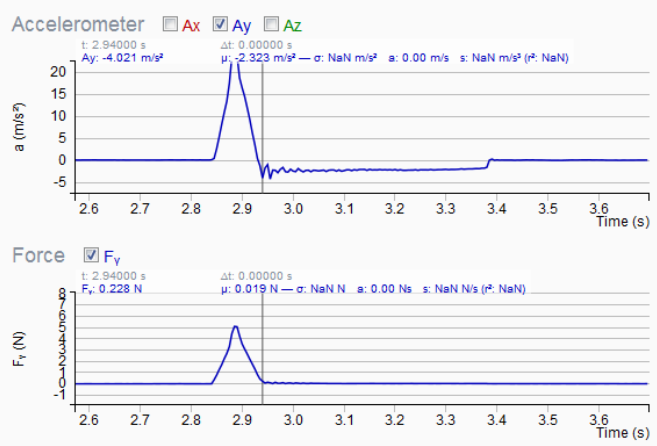


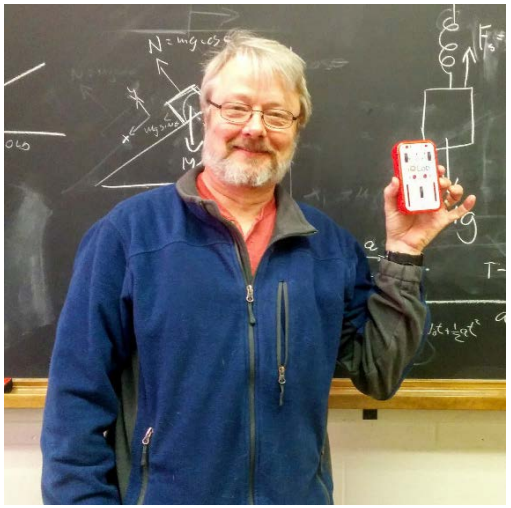
Summary

We have adopted a formative approach to dorm room experiments in our hybrid labs

Using these assignments, we

- Establish common experiences for future instruction
- Create a paradigm where many answers are “correct”
- Give students room to show us where they are in their learning process

Acknowledgements



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