Expanding a Model for Design-based Labs Supported by Whiteboards

BENJAMIN SPIKE

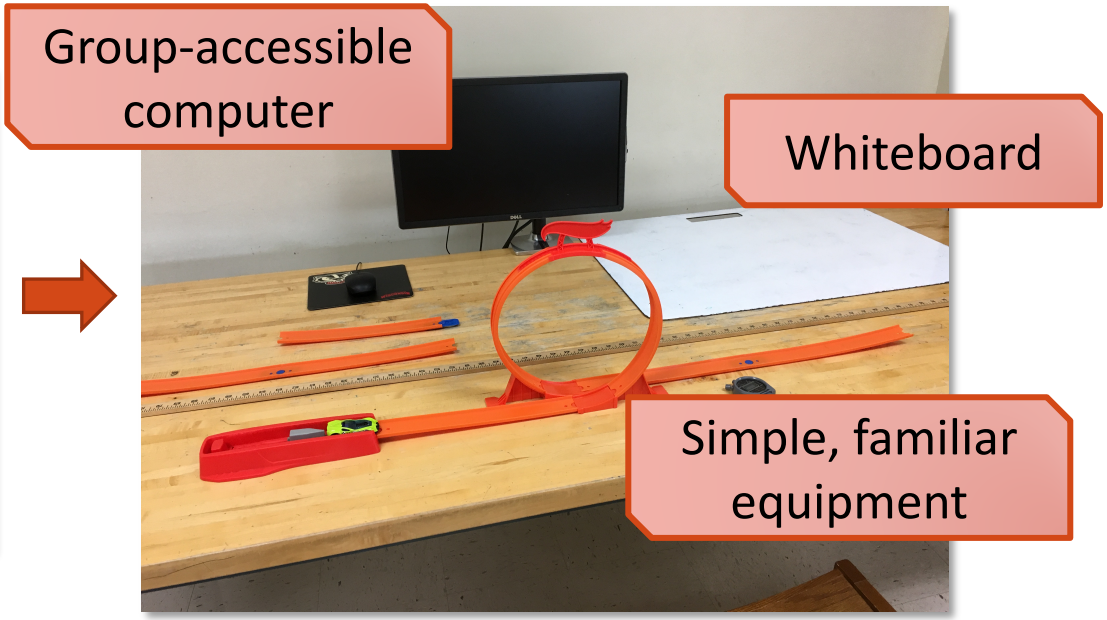
JULY 24, 2019

btspike@wisc.edu

Spring 2018

- Introduced design-based lab model to Physics 1 (alg.-based)
  - ~500 students/semester, 2-hr labs, 10 labs/semester

Traditional



Design-based

Guiding Principles for New Labs

- **Open-Ended Design**
  - "Capstone" of each lab is a **design challenge** with multiple possible solutions
- **Communication**
  - **Whiteboards** facilitate collaboration & communication
  - Mid-lab **"symposium"** provides forum to share ideas
- **Conceptual Scaffolding**
  - First half of lab **builds up** & **reinforces** principles that will be used in design challenge

Sample Whiteboard

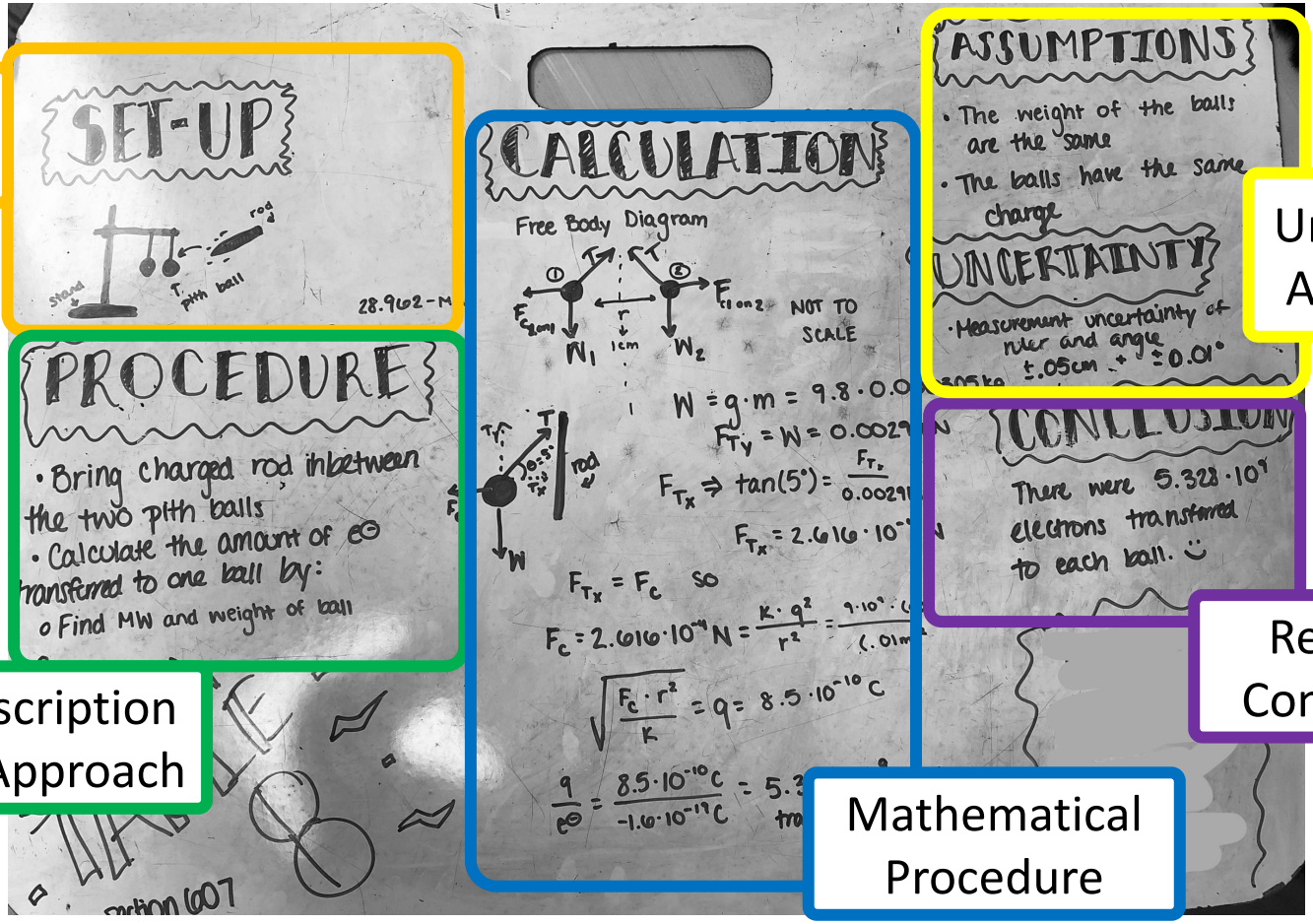


Diagram of Setup

Description of Approach

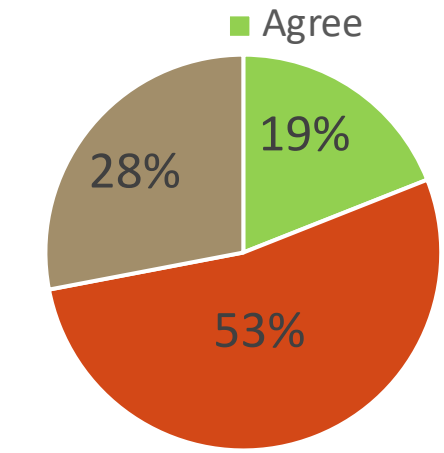
Mathematical Procedure

Uncertainty & Assumptions

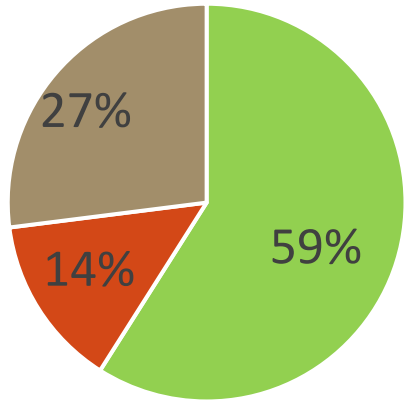
Results & Conclusions

Encouraging Sp18 Results

"I felt like I had to think creatively in order to be successful at the labs."

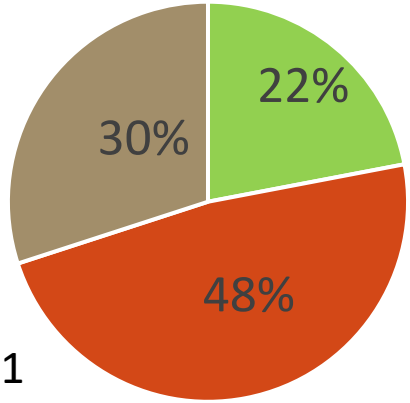


Traditional Physics 2

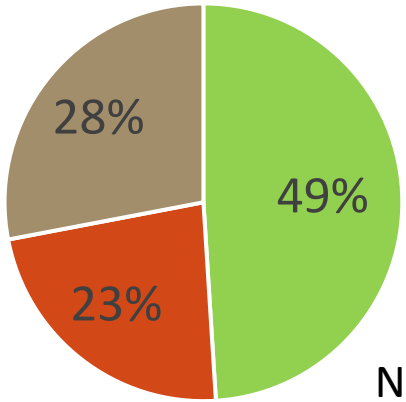


Design-based Physics 1

"Overall, I found the labs interesting."



N=371

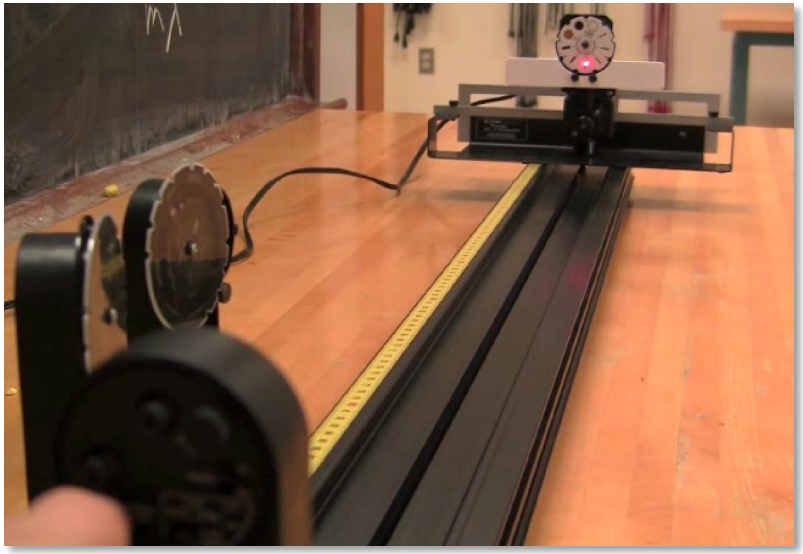


N=311

Fall 2018 – Spring 2019

- Model expanded to Physics 2
  - 10 new design-based labs supported by whiteboards

"Build a telescope using the lenses available to you."



"Measure the width of a hair using the diffraction pattern from a laser."

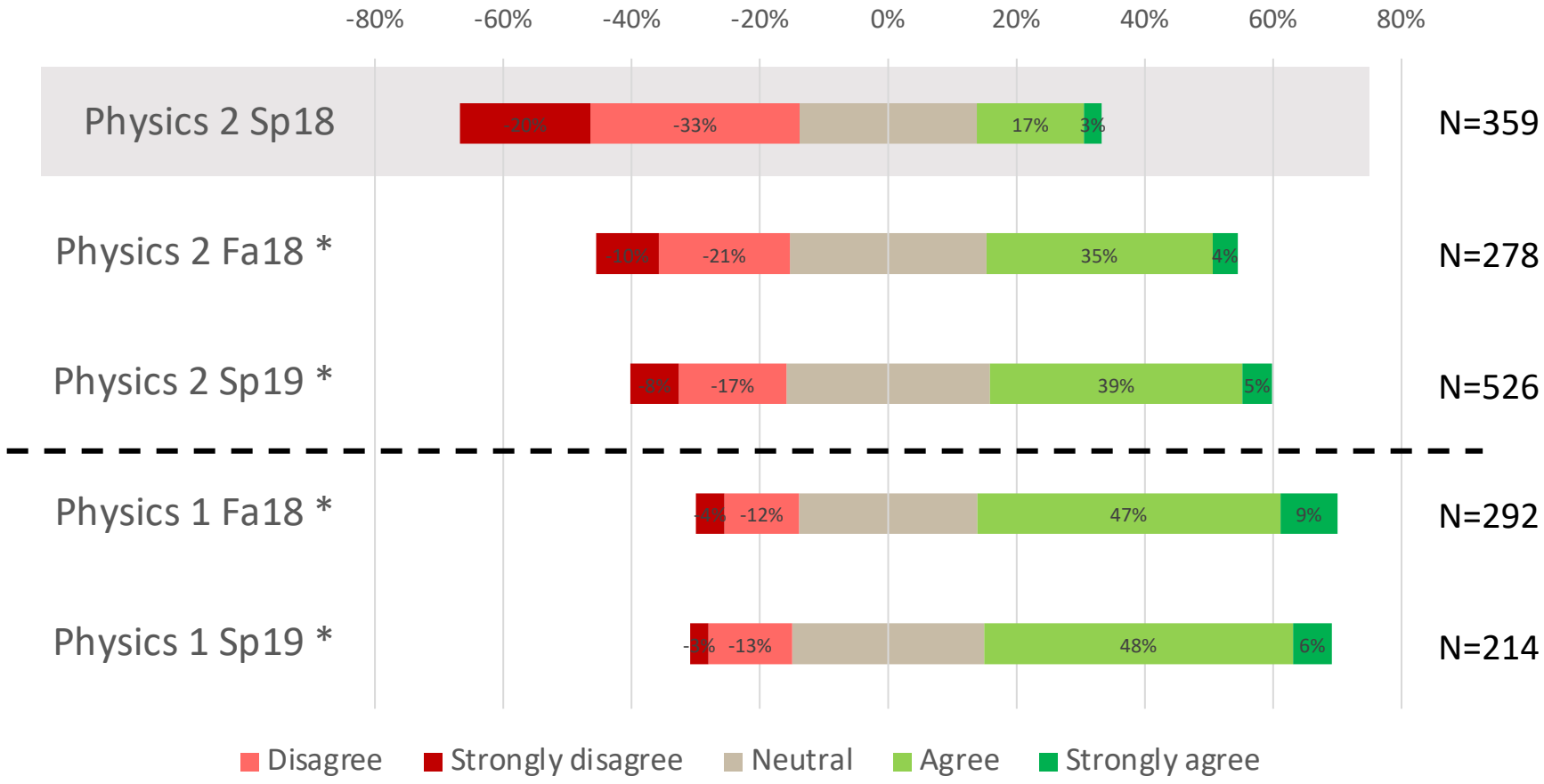
Post-semester Survey

- 12 questions, 5-point Likert scale
  - Strongly Disagree – Disagree – Neutral – Agree – Strongly Agree
- Administered with post-semester conceptual inventories during lab

Spring 2018	Fall 2018	Spring 2019
Physics 1 (New)	Physics 1 (New)	Physics 1 (New)
Physics 2 (Old)	Physics 2 (New)	Physics 2 (New)

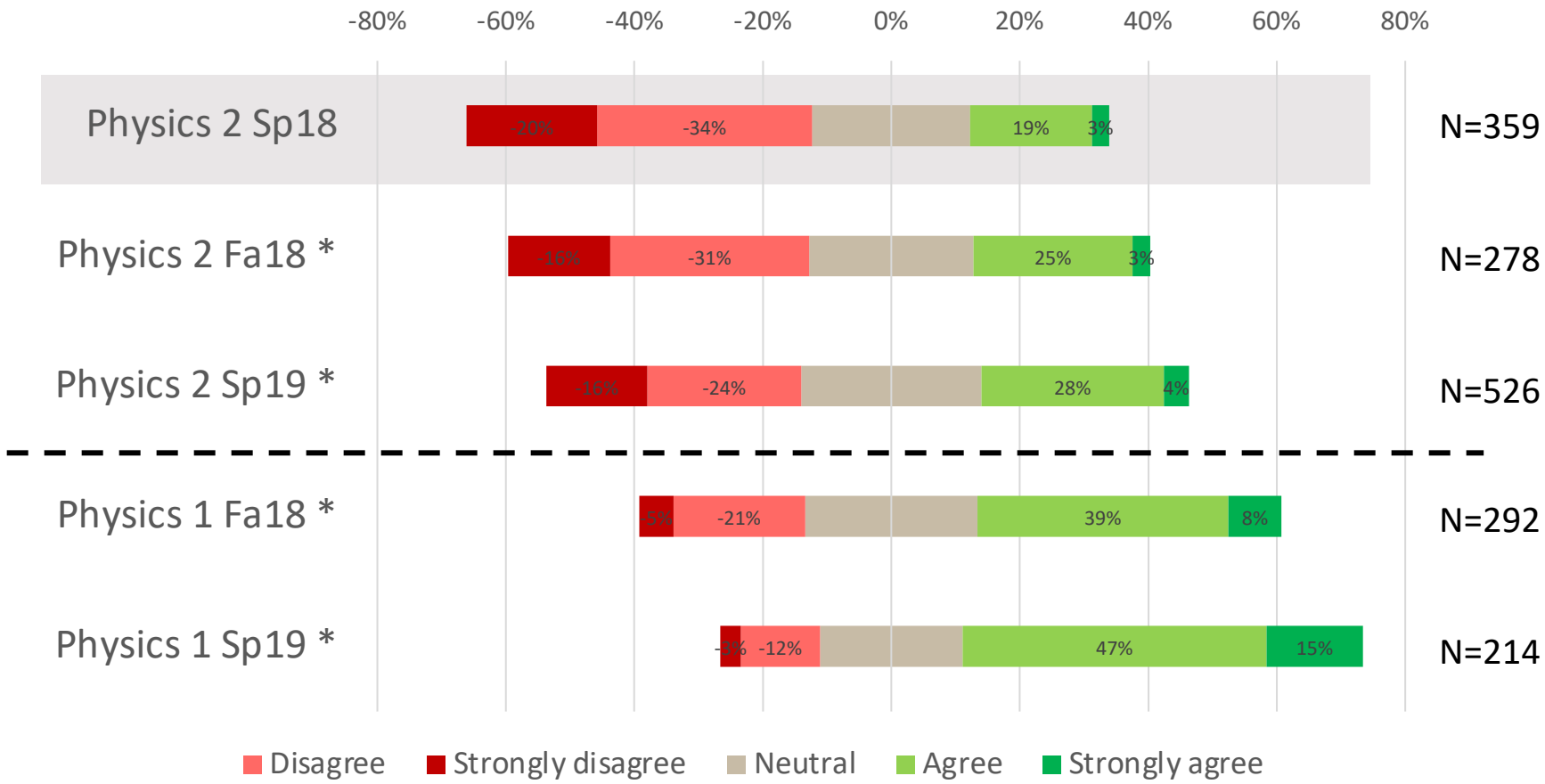
Results: Creativity

"I felt like I had to think creatively in order to be successful at the labs."

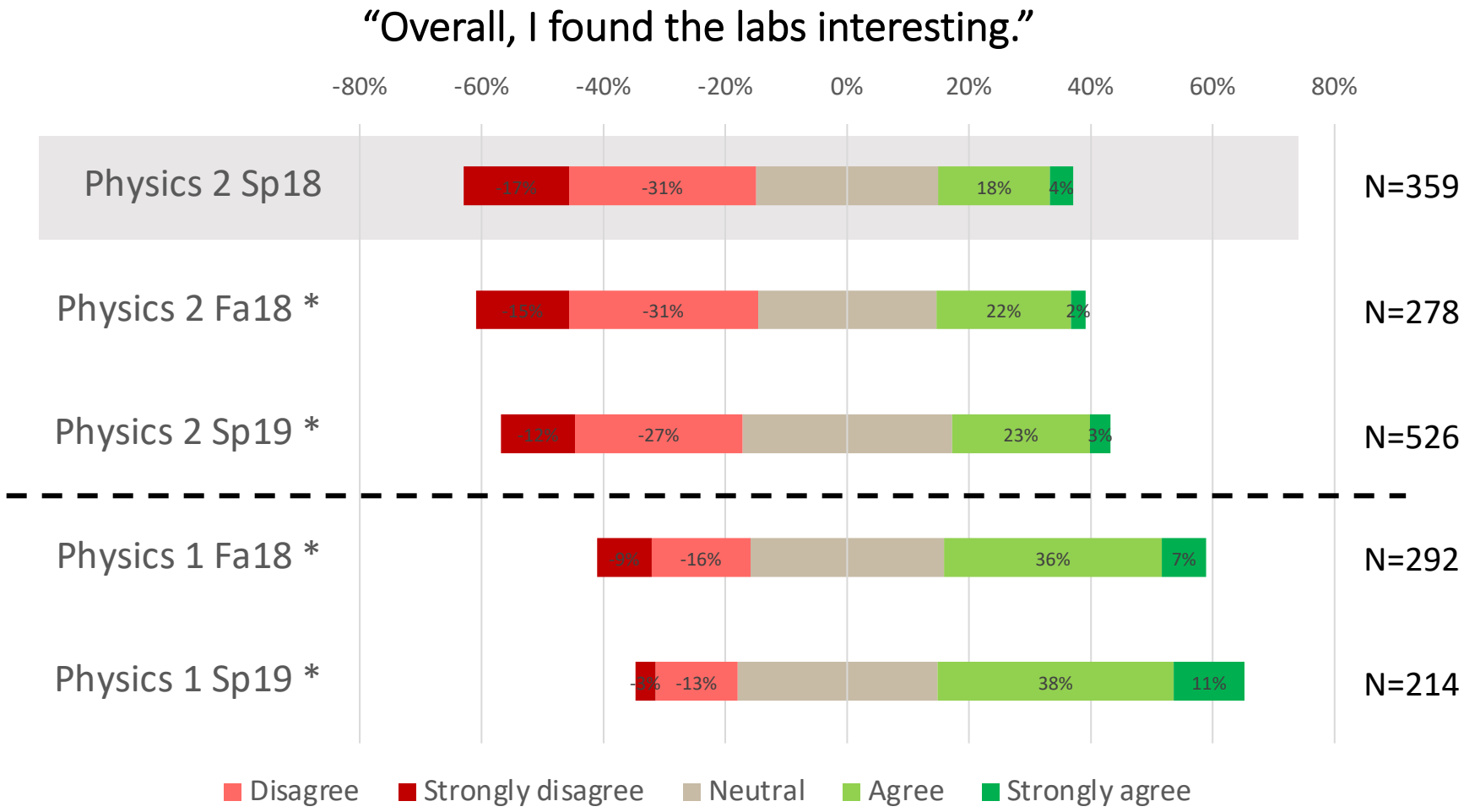


Results: Concept development

"The labs improved my understanding of physics concepts."

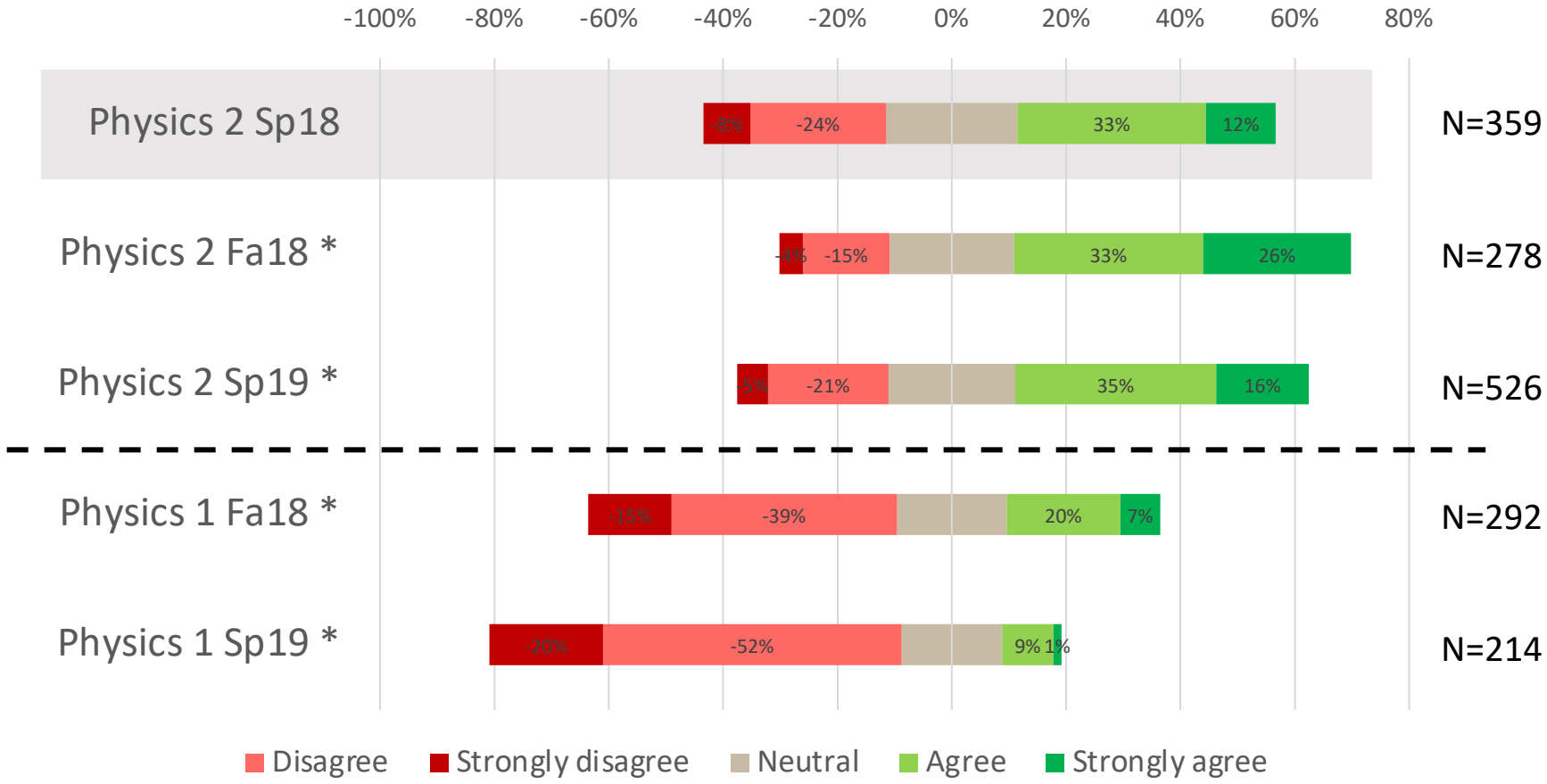


Results: Interest



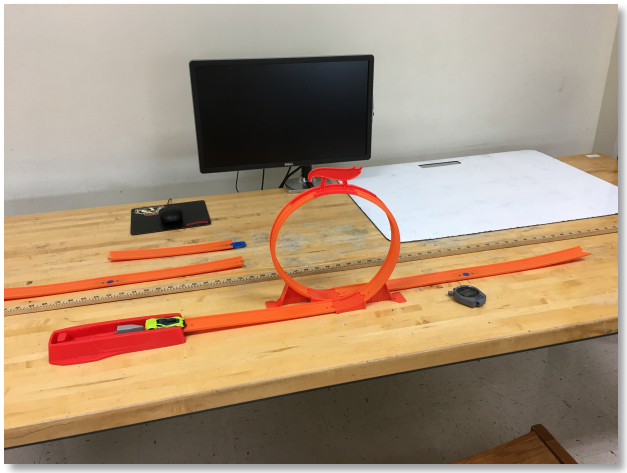
Results: Equipment

"I often had difficulty working with the laboratory equipment."



Our takeaways

- Students see the design-based Physics 2 labs as requiring more creativity, but do not find them more interesting
- New lab write-ups aren't enough
- Traditional Phys 2 equipment lacks "pick-up-and-playability"



≠

Summary

- There is substantial room for improvement in our design-based Physics 2 lab suite
- Reliance on traditional laboratory equipment in Physics 2 is possible factor

➢ **Future Directions**

- Redesign problematic Physics 2 labs from the ground up
- Test out approachable, adaptable tools (e.g. iOLab)
- Conduct classroom observations & interviews to better understand student experience in new lab model

Contributors

Faculty

Peter Timbie

Duncan Carlsmith

Mark Rzchowski

Sridhara Dasu

Albrecht Karle

Kim Palladino

Staff

Ben Spike

Daniel Thurs

Susan Nossal

Margene Anderson

Jim Reardon

Students

Tor Odden

Andrew Loveridge

Wren Vetens

➢ Supported by **REACH Initiative** @ UW-Madison