

# A “Flipped” Approach To Large-Scale First-Year Physics Labs

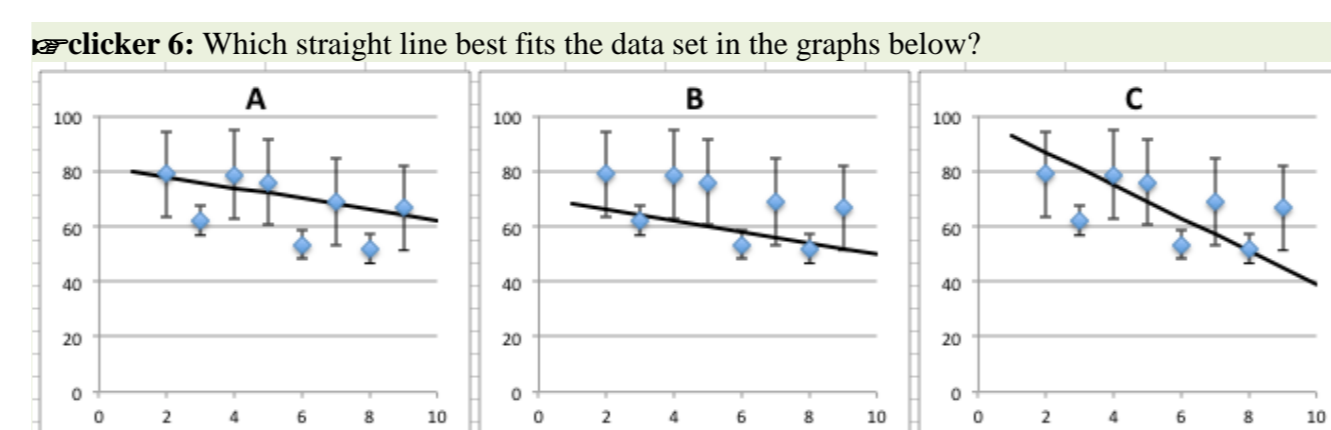
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## Features

- Inquiry-based, peer-discussions with clickers
- Phase 1: Builds Experimental Skills and Understanding of Data (8 weeks)
- Phase 2: Final Lab Project with Presentation (3 weeks)
- Homework connects labs:
  - Experiment at home – bring data to next session
  - Analysis at home – bring result to next session

## HW Marking

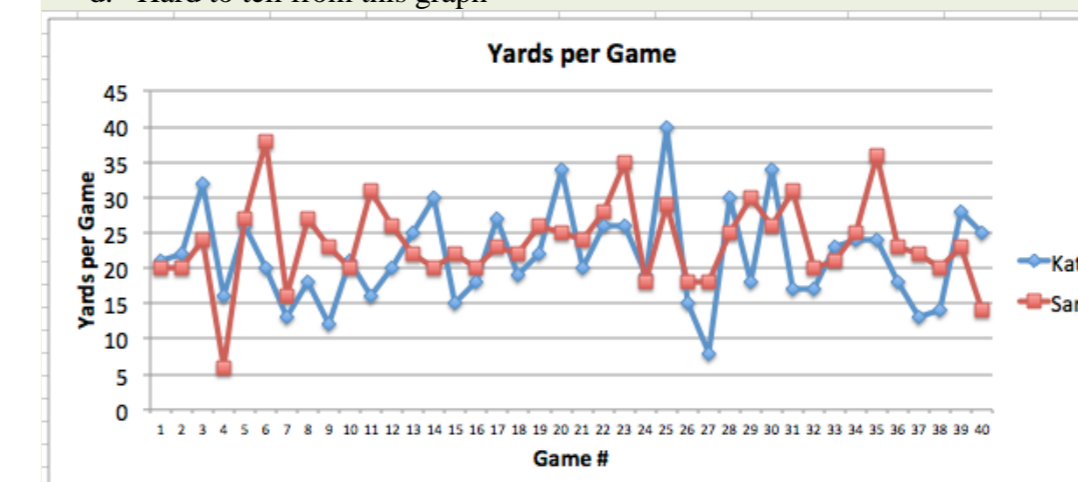
	Sufficient (✓)	Lacking (⚠)	Insufficient (✗)
Sufficient description of experiment			
Sufficient data was collected			
Calculation of average is sensible			
Estimation of uncertainty is sensible			



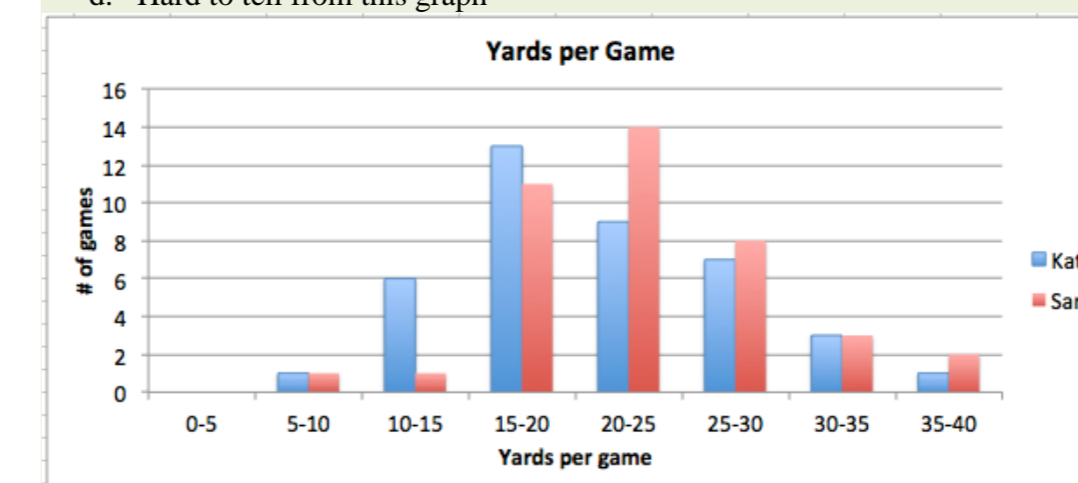
**Clicker 1:** A short refresher: the formula for SD is:  $SD = \frac{\sum(x_i - \bar{x})^2}{N}$   
 Sandy and Mandy measured the oscillation time of the same pendulum, in milliseconds. Sandy took three measurements and got 350, 400 and 425 ms. Mandy took six measurements and got 350, 350, 400, 400, 425, and 425 ms. Without calculating, who will have a higher SD?  
 a. Sandy  
 b. Mandy  
 c. They will have the same SD  
 d. Cannot be answered without calculating.

## Examples:

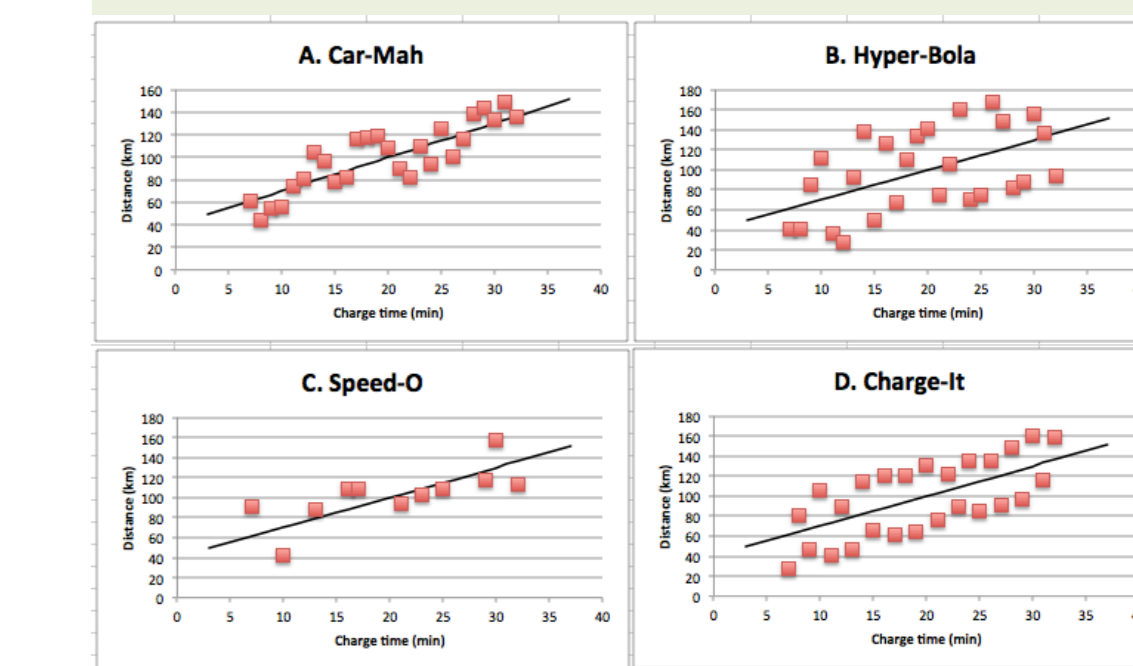
**Clicker 2.4: The more effective player:**  
 Sara and Kate are professional football players. An important measure for football players is yards per game. The following graph shows data from the last 40 games they played. Who is the more effective player?  
 a. Sara  
 b. Kate  
 c. They are equally effective  
 d. Hard to tell from this graph



**Clicker 2.5: The more effective player:**  
 Sara and Kate are professional football players. An important measure for football players is yards per game. The following graph shows data from the last 40 games they played. Who is the more effective player?  
 a. Sara  
 b. Kate  
 c. They are equally effective  
 d. Hard to tell from this graph



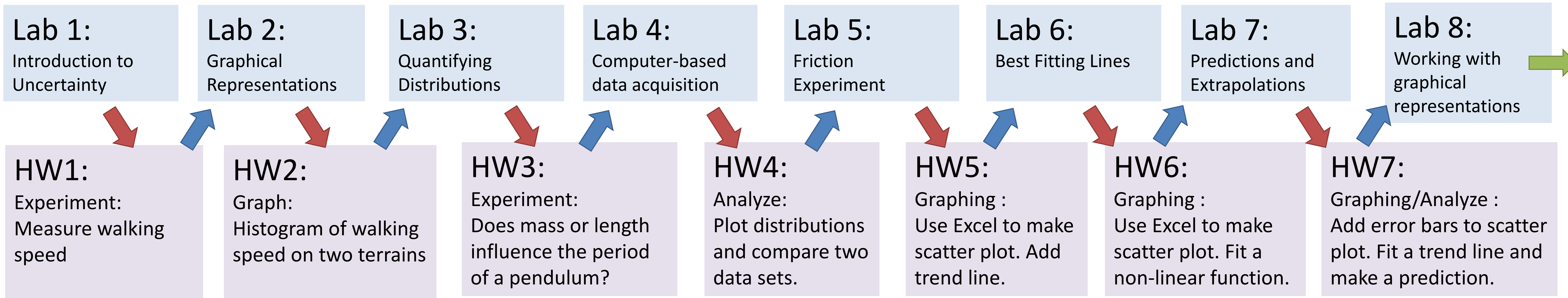
**Clicker 4:** Four different students set out to test how far an electric car can travel using a battery charged for different amount of times.  
 • Student 1 stopped after they thought the data looked good  
 • Student 2 started taking data with one type of battery, but then switched batteries half way through  
 • Student 3 took lots of data  
 • Student 4 varied both the charge time and the operating temperature



Match the students with the plots:  
 A) A3, B2, C1, D4  
 B) A2, B4, C1, D2  
 C) A2, B3, C4, D1  
 D) A3, B4, C2, D1

**Clicker 5:** Who do you think carried out the best experiment?  
 A) Student 1  
 B) Student 2  
 C) Student 3  
 D) Student 4

**Tasks**  
**Task 1: Planning (10 min, pairs)**  
 See what materials you have. Experiment with them. Plan your experiment. Start the software by choosing the “Lab Exam Force” icon on your desktop. Calibrate the force probes by clicking the “as zero” button, next to “Collect”.  
 The following questions will help you design your measurements. You can modify your answers once you gathered some data.  
 - The research question asks about the effect of mass on friction. How can you change the mass of the block?  
 - How many different masses do you plan to test? Why?  
 - How many times will you repeat each measurement?



**HW8:**  
 Think about a question and a plan for your final project.

**Feedback Session:**  
 Discuss project plan with peers and TAs.

**Presentation Session:**  
 Present your experiment.

**Poster presentations**  
 Go to the poster to your left and to your right, and evaluate these using the following questions. At all times, one member of your group should be by your poster, ready to answer questions. Please submit these pages to your TA at the end of the lab.  
**Poster #1**  
 Title of poster:  
 Names of group members:  
 Summarize the research question and conclusion of the poster.  
 What do you think are the best aspects of this poster?  
 What would you suggest to improve this poster and the experiment?  
 What would make an interesting follow-up experiment?