Brief introduction to physics for students who don't know how to read and solve overwhelming technical problems

Why do students with 4.0 GPAs get C minuses and D pluses in physics? Except in the easiest plug-and-chug physics courses, students need to read dense, technical language and methodically solve problems using allowed knowledge (not just guesses and feelings). For AP Physics, students also need to write explanations. The forensics program at a high school near where I live is a great place to develop these skills.

If you're not in that forensics program (or even if you are), tutoring with me is a good option. I break down the skills you need into very small steps. If you have reliable executive function, we'll aim to develop these skills in 3-5 hours. If you don't have reliable executive function, it will be clear within a couple hours (probably within an hour). If AP Physics 1 looks like a realistic option, we can continue tutoring for another 10-12 hours if you'd like to learn enough of the curriculum to take a mock Newton's Laws exam, which will show you why one of the tests around late October/early November at that local high school makes people cry.

Instructions for lesson 1 (additional materials on next page)

Day 1: Take notes that include instructions (allow 60 minutes if coach administers blank-page test)

1. Place an 8.5x11" sheet of blank paper in a landscape ("widescreen") orientation. Fold the sheet into four subpanels of equal size.
2. At the top center of the page, write the title "x-displacement".
3. Centered on the next line, write "1. Is scenario eligible for analysis with this sheet?"
4. Centered just under the central horizontal crease across the page, write "2. If scenario is eligible, continue using this sheet."
5. Fill in the rest of the sheet of notes using the model from the next page.

Day 2: Carefully read and diagram a problem (45-90 minutes)

1. Copy problem **K1** to a blank page. (Printing from a PDF is fine).
2. On an iPhone/iPad, open the reading guide at https://davidliao.com/read.php. Follow the steps. If you're working in a pair, you can have one person announce the instructions from the iPhone/iPad while the other person carries out the instructions for a few steps. You can switch roles every now and then.

Day 3: Solve the problem only using information in notes (30-90 minutes)

1. Use steps 2, 3, and/or 4 below (repeatedly, if needed) until all determinations requested by the problem statement have been made.
2. Try to use a note sheet:
    a. Pick a note sheet. Make a photocopy of the sheet.
    b. In the photocopy, use sections 1.a and 1.b to check whether the concept is eligible to be applied.
    c. If the photocopy isn't eligible to be applied, send the photocopy back to the pile of notes. If the photocopy is eligible to be applied, use section 2.a to update your diagrams, if possible, and use section 2.b to organize and calculate quantities, as much as possible.
3. Browse your photocopies. Check whether you can copy information from one photocopy on to another photocopy. If so, copy the information and look for additional calculations that you can now carry out.
4. If you've determined an expression for a requested quantity, box the answer (including the variable, an equal sign or inequality sign, the algebraic or numerical value, and, for numerical values, appropriate units).

Materials for lesson 1

Elapsed duration and x-displacement

1. Is scenario eligible for analysis with this sheet?

1.a. Inspect sketch

1.b. Document qualifications

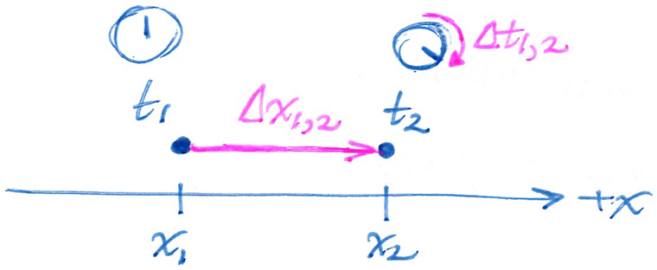
System (in bubble):	
+x direction (draw arrow):	
1st snapshot (replace each subscript 1 with this):	
2nd snapshot (replace each subscript 2 with this):	

2. If scenario is eligible, continue using this sheet.

2.a. Draw a diagram

Elapsed duration curve – directed arc traces sweep of clock hand tip

Displacement vector – arrow from 1st position dot to 2nd position dot



2.b. Fill in and compute values in a form

1st time	+	Elapsed duration	=	2nd time
t_1	+	$\Delta t_{1,2}$	=	t_2
	+		=	

1st x-position	+	x-displacement	=	2nd x-position
x_1	+	$\Delta x_{1,2}$	=	x_2
	+		=	

K1. A car moves along the x axis. A stopwatch is reset to read 0 seconds and then started. Three seconds after the stopwatch starts, the car is at an x-position of -43 m, then 35 seconds later, the car is at an x-position of 21 m. The x-displacement of the car is 10 m for the time interval beginning when the stopwatch displayed a time of 7 seconds and ending when the stopwatch displayed a time of 38 seconds. What was the x-displacement of the car for the time interval beginning three seconds after the stopwatch started and ending when the stopwatch displayed a time of 7 seconds?

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Materials for lesson 2

Average x-velocity

1. Is scenario eligible for analysis with this sheet?

1.a. Inspect sketch

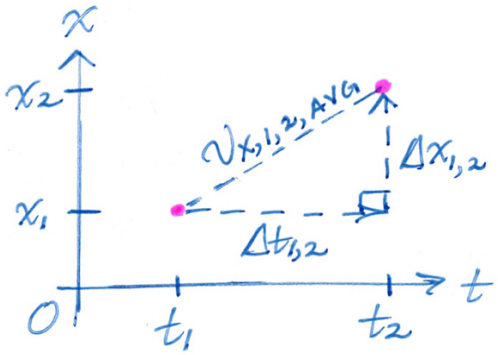
1.b. Document qualifications

System (in bubble):	
+x direction (draw arrow):	
1st snapshot (replace each subscript 1 with this):	
2nd snapshot (replace each subscript 2 with this):	

2. If scenario is eligible, continue using this sheet.

2.a. Draw a diagram

Represent an average x-velocity as the **slope** of the corresponding secant segment **on** an **x-t plot**.



2.b. Fill in and compute values in a form

Average x-velocity	·	Elapsed duration	=	x-displacement
$v_{x,1,2,\mathrm{AVG}}$	·	$\Delta t_{1,2}$	=	$\Delta x_{1,2}$
	·		=	

$$\text{Average x-velocity } v_{x,1,2,\mathrm{AVG}} = \frac{\text{x-displacement } \Delta x_{1,2}}{\text{Elapsed duration } \Delta t_{1,2}}$$

$$\boxed{} = \frac{\boxed{}}{\boxed{}}$$

K2. A runner moves along the +x direction along a straight racetrack. For the first 50 meters of the track, the runner warms up by walking with an average x-velocity of 1 m/s. Then, for the last 50 meters of the track, the runner runs with an average x-velocity of 7 m/s. What is the runner's average x-velocity for all 100 meters of the track combined?